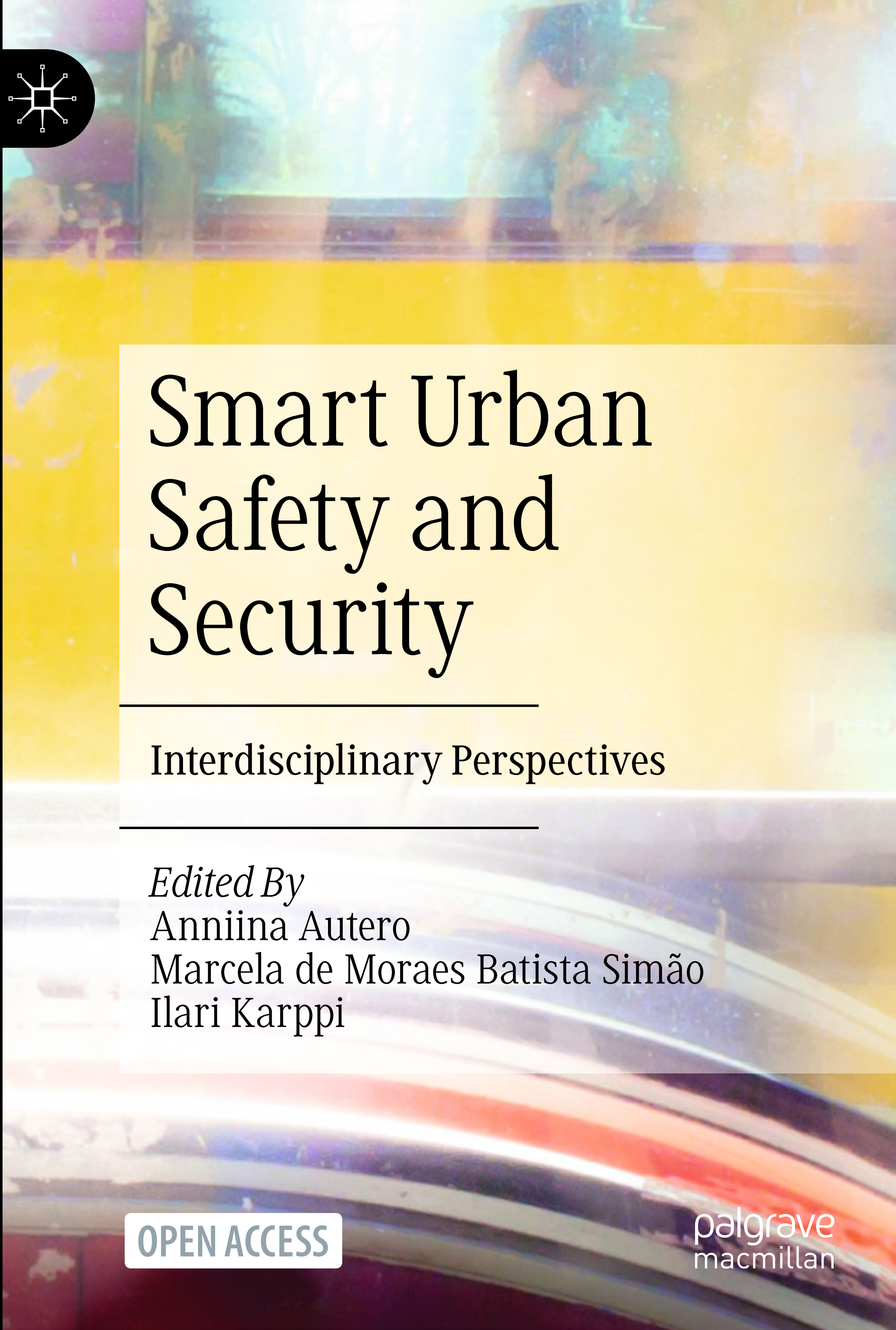

Smart Urban Safety and Security

Interdisciplinary Perspectives

Edited By

Anniina Autero
Marcela de Moraes Batista Simão
Ilari Karppi

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The editors would like to dedicate this book to all authors involved in this journey and to all stakeholders involved in the SURE project—the beginning of everything.

The editors also wish to dedicate this book to all SURE book stakeholders, and members of the Tampere University and City of Tampere staff funded through the Urban Innovative Actions and European Commission grant.

Preface

In the end of the SURE project, after facing the magnificent results the project achieved over the years, we decided to embark on a journey to write a book. We were well aware that this would be an uncommon path to bring forth results of a project funded by European Union Urban Innovative Actions Initiative (UIA). Yet, this only heightened our excitement about the idea of doing so. We were looking forward to a groundbreaking approach on a truly multidisciplinary and multi-professional issue. Discussing urban security has become increasingly relevant, important, and crucial for cities worldwide.

We faced a plethora of choices, possibilities, and topics. The first significant challenge to contemplate was about determining the most relevant direction for the research. After extensive discussions that followed, we opted not to go along just one but many roads. Urban security was the centerpiece of the study but explored from different perspectives, through varying layers of theory and cases. The book originated from the Smart Urban Security and Event Resilience (SURE) project carried out in Tampere, Finland. However, we wanted to expand the book's geographical scope beyond the project's original site and explore relevant topics, cases, and scenarios worldwide.

How to seamlessly integrate different fields and still make sense in a book about urban security? This question sent us to organize and attend in several workshops and forums to discuss with experts who reflected the multiplicity of the issue at hand. However, we were convinced that the main idea should focus on providing readers with opportunities to see security in the urban frame. While security is generally approached as human endeavor, it is also a question of artificial intelligence, mobility, technology, simulations, algorithms, events, resilience, social return, decision-making, and much more.

Urban security is a field full of practical solutions related to locally identified security needs. Recognizing the need for theoretical approaches, we crafted a book that combines theory with these practices. To extend beyond Europe, we chose one of the most famous cities globally—Rio de Janeiro. Hosting two mega events, 2014 FIFA World Cup and the Summer Olympic Games in 2016, made Rio both visible and interesting as an event city with massive security and urban development needs.

The book in its final form reflects the many dimensions of security in its urban contexts. Our key aspiration while compiling it has been to make it meet with the interests of readers with diverse academic and professional backgrounds. The effort of every author has been elementary for reaching this goal. This wasn't a book crafted by just a few hands; it was written by more than ten hands, minds, and hearts. As editors, we had the opportunity to learn from everyone involved, and this book is a culmination of a tremendous amount of work.

Our journey comes to an end with this pleasant outcome. We sincerely hope you enjoy it too.

Tampere, Finland

Anniina Autero
Ilari Karppi

Acknowledgements

'No book is an island'. While the financial support from several institutions, and particularly the European Union Urban Innovative Actions Initiative, was elementary for completing this book, a wide community of fellow researchers is also to be credited. As urban safety and security are complex and, in a way, 'boundless' topics, also the colleagues whose insights we have been privileged to rely on while testing our ideas come from a wide disciplinary and professional backgrounds.

We wish to thank Amy Chester, Janne van Doorn, Kalle Vaismaa, Martti Juhola, Olli Kultalahti, Pirjo Jukarainen, Rune Saugmann Andersen, and Sari Yli-Kauhaluoma for their valuable comments on earlier versions of many of the book's chapters. Cooperation with Minna Säpyskä-Aalto, Petri Nykänen, Petri Koskinen, Niko Reinvall, Janne Perälä, Janica Virkkunen, Petri Aalto, Petri Murtomäki, Antti Perttula, Antti Asiala, and Anniina Ala-Kitula took place on nearly daily basis in the SURE project.

We also enjoyed the expertise of Isabelle Schneble, Anna-Kaisa Ikonen, Teppo Rantanen, Tero Tenhunen, Markus Joonas, Tiia Joki, Outi Valkama, Antti Saari, Pekka Ranta, Noora Kumpulainen, Minna Seppänen, Mikko Siitonen, Tarja Kaasalainen, Mervi Huhtelin, Esa Kokkonen, Hannele Räikkönen, Petra Kortelainen, Lotta Honkanen, Aleksi Kopponen, Kaisa Mustajärvi, Annika Kettunen, Minna Leno, Maria Falcken, Sointu Karjalainen, Kimmo Kytösaari, Riikka Kytösaari, Mika Hyytiäinen, Veli-Matti Heinijoki, Jouni Perttula, Annina Nääppä, Juha-Matti Mäkitalo, Kristiina Auranen, Ari Andreasson, Mika Heikkilä, Mika Kulmala, Maarit Vehviläinen, Markku Niemi, Jari Ikonen, Anni Joela, Kristian Valkama, Janne Nieminen, Juho Yli-Korpi, Stephen Gregory, Jussi Kulomäki, Jussi Koskela, Annukka Larsen, Teemu Skogberg, Markku Pakarinen, Jari Kuusisto, Veli-Pekka Salo, Tomi Keskinen, Heikki Finnilä, Riku Sourama, Jorma Tuuna-Väiskä, Anna-Kaisa Heinämäki, Perttu Pesä, Saara Saarteinen, Matilda Salminen, Marko Stenström, Marko Korpela, Karoliina Hartman, Josefina Riuttala, Tiina-Maija Mattila, Henri Helve, Siiri Nieminen, Perttu Heino, Hanna-Greta Puurtinen, Tuija Ylä-Viteli, Satu Kylmälä, Carita Forsgren, Ari Koivumäki, Antti Perälä, Pekka Pöyry, Markus Aho, Joni Nieminen, Antti Rasila, Petri Reiman, Timo Laurila, Ilkka Makkonen, Penuel Rantakangas, Teemu-Taavetti Toivonen, Perttu Mukkala, Aleksi Mertsalmi, Harri Nojonen, Ismo Rajala, Harri Lehtimäki, Anssi Aunola, Teemu Knuutila, Petri Ahokas, Ville-Veikko Karppanen, Joni Aalto, Harri Airaksinen, Seppo Haataja, Minna Päivinen, Sirpa Virta, Risto Honkonen, Tiina Kuusisto, Pentti Savolainen, Edna Pezard, Helena Monteiro, and Elizabeth Johnston.

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Cédrick Cunha Gomes da Silva (PhD) has a background in mobility studies specializing in public policies and the politics of urban spaces. Currently, his undergraduate teaching focuses on urban political economy and technological systems. His postgraduate lecturing focuses on social and participative public management. Cédrick's research draws on post-structuralist political theories as it explores the complex relationship between bodies, spaces, practices and urban infrastructures. His current research focuses on territorial (dis)order, surveillance and concerns for equitable and plural access to urban life. He leads the research group

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Jaana Hallamaa (PhD) is Professor of Social Ethics at the University of Helsinki, Faculty of Theology. Her research interests have extended to both theoretical and practical, or applied, ethics. During the past three years, Hallamaa has concentrated on AI ethics and human computer interaction within complex sociotechnical systems. Hallamaa is currently writing a monograph *Ethics of Failure: Errors, Mistakes and Wrongdoing in Social Action*.

Alexandre Hojda (PhD) is an economist with a PhD in Urban Management with a focus on Smart Cities. He worked at three levels of government in Brazil; he also worked on private projects and environmental studies. He has experience in the implementation of Urban Command and Control Centers (CCC) projects; he was the coordinator of the Curitiba Operations Center project for the city of Curitiba (Brazil). He has publications in the area of smart cities, urban data, and command-and-control centers. Nowadays he works connecting Israel's technology and innovation sector with the Latin American market.

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Konstantina Karydi is a professional with experience on urban resilience, climate transformation and change management focusing on solutions to address twenty-first-century risks and challenges. She currently works as Senior Advisor and Europe Representative to Resilient Cities Catalyst (RCC) and serves as advisor and high-level expert for multilateral entities and organisations such as the European Commission, European Urban Initiative and UNDRR Making Cities Resilient 2030

Campaign. She has held positions as Associate Director EME and Climate Transformation Lead for the global 100 Resilient Cities Initiative of the Rockefeller Foundation, Special Advisor on Resilience and Social Security to the Minister of State, at the office of the Greek prime minister Alexis Tsipras and Senior Advisor to the Mayor of Athens, Giorgos Kaminis, with a focus on the EU Urban Agenda and Head of Strategy. In her various capacities she has had the opportunity to teach as a guest lecturer in leading global universities such as EPFL, Harvard, LSE and the University of Athens and to publish and contribute to a number of strategic and urban policy-related projects and publications such as the Urban Resilience Strategies of Tel Aviv-Yafo, Glasgow, Barcelona, Paris, Athens, Thessaloniki, the Future of Cities Report by JRC and the European Urban Initiative Climate and Security cluster.

Paul-Erik Korvela (PhD) is a political scientist and currently University Lecturer of Political Science at the University of Helsinki. He has also worked at the Universities of Jyväskylä, Tampere and Turku. In addition to political science, he has also taught international relations. His research interests are considerably wide, ranging from political theory and conceptual history to international relations, management, and future studies. He has done research visits to University of Verona, City University of Hong Kong, University of Malaga and Hong Kong University. Dr. Korvela has published eight books, including textbooks that are used in the political science curriculum, and articles in journals such as *Geopolitics*, *History of the Human Sciences*, *Redescriptions* and *Economic and Political Studies*. He has been the editor-in-chief of the national political science journal (2015–2016) and a member of board of several scientific journals.

Sari Mäenpää (D.Sc.Tech.) is a senior business development manager working for safe and secure society in Insta Advance Ltd. She is interested in situation awareness-related issues as well as research and business collaboration, especially in smart-city context.

Pedro Martins is a smart-city-driven professional with 10 years of experience in planning and innovation management (inside the Rio de Janeiro City Operations Center—COR), with a strong background in command-and-control projects to enhance the efficiency of the urban logistics operations, natural disasters response, and to implement smart-city solutions. Between 2015 and 2016, he coordinated the implementation and operations of the first transportation integrated command and control center of Rio de Janeiro State (CIMU as the Portuguese abbreviation), which ran during the Rio 2016 Olympic Games. Pedro co-founded the ongoing Forum for Cities Command and Control Centers (#FORUM4C), first online ambient in Latam 100% dedicated for knowledge exchange and projects for city control centers.

Nicholas Melgaard is currently preparing to submit his PhD doctoral thesis on moral philosophy in modern armed conflict. A part-time doctoral candidate through the King's College London Defense Studies program, Nick works full time as a Management Consultant in Finland, with prior experience supporting private sector and government clients in the implementation of AI. Before this, Nick served for seven years as an infantry officer in the British Army, deploying on a range of operations and specializing in information operations and intelligence. He holds undergraduate and master's degrees in philosophy and the history of philosophy from the University of Cambridge, and a master's degree in international relations from the School of Oriental and African Studies (SOAS).

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The main field of interest has been expertise and expert thinking, foundations of science, usability, user experience and design research.

Iina Sankala (M.Adm.Sc.) works as a researcher at Tampere University, specializing in sustainable urban and regional development. Her other areas of expertise include urban governance, smart mobility, sustainable urban (transit) planning. In SURE project, Iina has worked with topics including safe and secure cities and socially acceptable ways of using smart solutions in urban safety and planning of events. She also contributed to SURE project's communication activities.

Simone Silva has been a public servant of City of Rio de Janeiro since 2008. Previously, she worked as Mobility Director of the City of Resende, Rio de Janeiro, a medium-size city. She always works on sustainable mobility projects. From 2011 to 2016, she worked on transport projects that reshaped the city transit network such as implementation of 120km of BRT and interchange stations (BRT-Train, BRT-Metro). She also coordinated the Sustainable Mobility Plan using community participation tools and the successful Transport Plan for RIO2016 Olympics and Paralympics Games. From 2017 to 2020, she changed the focus toward pedestrian and cycling-oriented projects and policies, mobility data and low carbon transport. As CEO of Traffic Engineering Company of Rio de Janeiro, she promoted changes toward pedestrian and cycling initiatives. Currently she is the Chief of Sustainable Mobility Fund, and also a part of the team of the main transport projects such as bus acquisitions, new ticketing system, Rio Cycling Plan and Mega Events Planning, such as Rock in Rio. Her education includes Architect and Urbanist Bachelors and Masters in Transport Engineering from the Federal University of Rio de Janeiro and short courses in Local Economic Development from his, South Africa, and Public Management, Political Management and Governability Program from FGV/CAF, Urban95from LSE.

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Introduction: Changing Security, Transforming Governance

Anniina Autero and Paul-Erik Korvela

The questions, problems, and practices pertaining to security permeate numerous disciplines. If one considers the academic division of disciplines, security emerges as one of the most fundamental themes within a specific field of study, namely, international relations. As Stritzel and Vuori (2016) highlight, questions revolving around the concept of security have been central to international relations since the domain's inception as an academic discipline. One could also argue that the early pioneers or foundational figures in the field of international relations such as Machiavelli and Hobbes addressed, first and foremost, the questions of security, even though they might not have had access to the terminology and conceptual clarity found in present-day security discourse. Conceptual investigations into security began in earnest only in the

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1980s, and these critical studies have thence forward questioned many of the theoretical and practical givens in the realm of international politics (ibid.).

For a long time, the state constituted the framework within which issues of security were discussed. It was the state's security against external and internal threats that dominated security concerns (see Buzan & Hansen, 2012). During the Cold War era, state security witnessed its heyday. Internal issues were considered subordinate to and of lesser significance when compared with external threats. Game theory scenarios focused on mutual assured destruction with nuclear weapons dominated security discourse; all other security concerns were perceived as irrelevant if the survival of the state was not secured first. With the conclusion of the Cold War and by virtue of numerous other trends and transformations, the focus and referent of security have changed. Academic literature refers to this change as the widening of security discourse. Issues related to human security have emerged alongside state security (see Hanlon & Christie, 2016).

With this transformation, the study of security has simultaneously widened. The so-called Copenhagen School of international relations has paid attention to the linguistic processes through which security and threats in particular are produced (Buzan et al., 1998). Language, rhetoric, and speech acts are central to our perception of issues threatening our existence. This means new issues can be "securitized" by portraying them as threats. Consequently, numerous issues previously not included in the hard security discourse now emerge on the agenda of actors entrusted with the security and safety of urban environments, events, and the like. This also means that many other disciplines have directed their attention towards security, given the exponential increase in potential security concerns. Anything from natural disasters to pandemics and from pollution to terrorism is translated into the language of security (not to mention hybrid threats that do not really have a clearly defined form to begin with but can include almost anything).

Human security, particularly the subjective sense of security experienced by people in a given space, constitutes an essential component of modern urban planning wherein cities are planned for individuals by taking into account the human dimension and their sensory experience (Gehl, 2010). Cities plan and provide public urban spaces that enable interaction between people and the city (Ozan, 2017). Security of these public spaces is ensured by a weft of governmental, regional, private sector, and non-profit actors. This requires smooth cooperation and modern technological tools.

Improvements in technology have transformed and continue to transform practices related to security. While a majority of these innovations represents the dark side of being employed as tools of surveillance, especially by autocratic governments, they also offer a wide array of beneficial uses and fulfil numerous purposes. Technology in itself is often neutral, with its impact largely depending on its use. One could reference here the splitting of the atom, which can produce energy or nuclear bombs. Another obvious example is the Internet, which can disseminate information, give voice to otherwise repressed groups, and act as a tool of democracy or, depending on the actors and purposes, do quite the opposite. The same applies to many of the tools and practices utilized to establish urban security.

While the discourse of security has widened and an increasing number of issues are being granted inclusion within the confines of the domain of security, the actors producing this security have grown in numbers and now include constellations and partnerships previously unknown. In the last decades, major transformations have been observed in the manner in which modern states are governed. The most pivotal transformation has been the change from government to governance. A series of undulating reforms dating back to at least the 1990s have altered the administrative apparatuses of Western democracies and the ways in which they are governed. As Mark Bevir (2010) among many others has argued, the old-school notions of government have been ousted in favour of expertise, partnerships, networks, and markets. Many of the services previously provided by the state are now produced hand in hand with quasi-governmental and private organizations as well as civil society. This new normal is also the reality in the field of security. More often than not, officials work hand in hand with non-officials, which creates some possibilities and poses certain challenges. The relationship between security and democracy is far from clear and acts for improving security can easily be violating privacy or disrupting democratic processes (Huysmans, 2014). The proliferation of "security talk" manifests itself in the addition of various prefixes and suffixes to the term security, such as food security, energy security, and the like. With the rapid escalation in security concerns, our mentality changes, and we start to perceive insecurities and threats in various aspects of our lives, as Huysmans argues (ibid.); consequently, our societies become easily permeated with scattered security practices. Suspicion becomes the default state of mind and insecurity the organizing principle of governance. The changing role of security requires robust social skills for effective cooperation and interaction with the most diverse actors, abilities to build and manage network relationships, and commitment to strong ethics from the representatives of public interest (Virtanen & Stenvall, 2011). As researchers, it is incumbent upon us to focus on these dimensions of security discourse.

The book at hand addresses urban security issues partly with and partly without a self-aware reflection on these abovementioned transformations. Nevertheless, this exploration is somehow path-dependent on these larger trends. In their own ways, the chapters in this book evaluate the ideas and concepts that guide our thinking related to security, offer new and interesting re-thinking of these issues, and widen our perspective as to what security encompasses and how it is produced.

The book initiates an in-depth exploration of urban security, examining it from both theoretical and practical perspectives. The twelve chapters selected for this book collectively delve into the theoretical framework underpinning urban security, paving the way for more pragmatic approaches to the associated issues. Teija Vainio's chapter introduces a vision for new urban informatics, asserting that the sustainability of technology and the subjective sense of security are intricately linked. The chapter provides an analysis of recent urban informatics research, particularly in relation to sustainability and security concerns, from the viewpoint of the citizen. While highlighting the potential of technological innovations, the chapter also issues a cautionary note about their limitations and emphasizes their inability to replace human moral judgement.

The chapter by Cedrick Gomes and Marcela Simão, titled "Watch Out: Surveilling Cities and New Outlines of Space and Time", offers a critical re-thinking of the confines within which urban life takes place.

For example, building on the theories of Paul Virilio and Stephen Graham, the authors address the question of how our everyday experiences are shaped by the proliferation of ubiquitous digital and communication technologies. Re-thinking basic concepts can provide fertile ground for the germination of innovative public policies and urban planning, besides facilitating the recognition of pluralities within the topologies of urban cities. The SURE project served as an illustration of this innovative and re-thinking approach to security.

The chapter, authored by Ilari Karppi and Iina Sankala, traces the evolution of security thinking in Tampere, a post-industrial city in Finland, and explores how the event industry and its regimes of security have shaped the cityscape. The fulcrum of the analysis rests on the multi-stakeholder processes providing this security. The fourth chapter delves deeper into this co-creation of urban security, arguing that the vocabulary of co-creation and joint effort implies mutual trust and shared awareness. The case study where this phenomenon is studied involves situational awareness, during the SURE project activities, within the context of simulated urban security exercises in a situation room. The results shed light on the possible factors that affect the outcome of joint security exercises.

In the fifth chapter, Remco Spithoven and Jelle Brands provide a comprehensive examination of the safety and security aspects of urban large-scale events. It delves into a unique perspective by exploring the fear of crime in relation to events and festivals. They conduct a comprehensive survey of articles published on this topic to underscore its relevance and significance in the context of event security relative to fear of crime and violence. The chapter explores that there is evidently no universal solution for alleviating the fear of crime at events and festivals. When tackling perceived safety issues and fear of crime, it is imperative to identify underlying causes and establish realistic goals achievable by professionals.

Konstantina Karydi's chapter centres on the concept of urban resilience. This chapter places the global evolution of urban resilience in context, comparing its role in altering management practices in local administrations and serving as a primary policy objective to confront the unprecedented shocks and stresses of the twenty-first century. It discusses how resilience, an old term from ecology and human psychology, came to dominate urban planning discourse without any clear unanimity on its meaning or definition. The chapter provides a comprehensive review of the urban resilience agenda as a crisis management tool for risks and problems. It involves the formulation and application of a change management process aimed at enhancing capacity and fostering efficient horizontal collaboration among traditional safety and security stakeholders, such as the fire department, event management entities, municipal services, and citizens.

The chapter by Henry Joutsijoki and Sari Mäenpää focuses on crowd counting using camera surveillance as a major role. The chapter debates the importance of preventive public safety and security as key priorities. The prevalence of large-scale public events, including concerts, sports events, and demonstrations, necessitates proactive measures from both safety and security authorities and non-authoritative entities. The approach adopted in the chapter is broad, encompassing the entire process of crowd counting from camera technology and algorithmic development to issues of privacy and surveillance. The authors highlight considerations when implementing crowd-counting measures as preemptive security tools in events and festivals, using the SURE project as a concrete example.

The chapter by Nicholas Melgaard discusses the outsourcing of moral judgements to artificial intelligence. He assumes a critical stance towards the collaboration between analytic philosophy and policy in the rise of the "moral machines". Moreover, the chapter issues a congenial warning and risks against the limits of technological innovations and discusses their inability to replace human moral judgement. Hence, through distinct approaches, all chapters theoretically evaluate the very framework within which urban security and safety "takes place", so to speak, and examine the kind of discourses and ideas that guide attempts to manage the same.

The next chapter by Jaana Hallamaa, Jyrki Nummenmaa, Tomi Janhunen, Timo Nummenmaa, Pertti Saariluoma, and Elizaveta Zimina proposes meticulous modelling of agents and their ethical concerns for designing acceptable AI systems, with a focus on shopping mall security as a case study. The authors contend that the introduction of complex AI systems in private and public spaces carries ethical consequences for security agents and all layers of society. They argue that these concerns should be considered and duly acknowledged when designing these systems.

Ilari Karppi, Iina Sankala, Henry Joutsijoki, and Sari Mäenpää's chapter delves deeper into the co-creation of urban security, asserting that the vocabulary of co-creation and joint effort implies mutual trust and shared awareness. The case study examined is situational awareness in the situation room of simulated urban security exercises. The results provide insights into the potential factors influencing the outcome of joint security exercises.

The next chapter moves to a different continent and context, remaining within the realm of security. It presents ideas and best practices utilizing security technologies, including a Command-and-Control room, to enhance the safety of urban spaces, focusing on Rio de Janeiro, Brazil. The chapter explores the operational intricacies of the Command-and-Control Rio (COR), especially during significant events such as the FIFA World Cup, the Rio Olympics in 2016, and the annual Rio Carnival parades. It illustrates how technology can enhance safety and security effectively, emphasizing the crucial role of communication among city departments for the success of such events. Pedro Martins, Alexandre Hojda and Marcela de Moraes Batista Simão address various aspects in this chapter, including communication strategies, integrated operational planning, real-time monitoring, and risk assessment, all aimed at enhancing safety and security during large events.

The twelfth chapter moves out a little of the security universe and goes into the importance of mobility to the success of large events. Simone Silva and Jaqueline Torres explore the significance of people flow, public transportation, safe pedestrian routes, and risk management through technologies and data in their research. The chapter centres on the Rio Olympics in 2016, which drew an audience of approximately 2.5 million people. Managing urban mobility during mega-events requires multi-level governance and public-private partnerships, especially involving security stakeholders. In Rio de Janeiro, the establishment of the Integrated Urban Mobility Centre (CIMU) is highlighted. This monitoring and transport coordination unit, operating within the City Operations Center (COR, Portuguese acronym) during the Games, brings together representatives from all transport operators across the entire metropolitan area of Rio de Janeiro.

The final chapter of this book examines the social return on investment of SURE as a measurable social value in urban security. Anniina Autero, Alisa Jashari, and Marcela Simão model the potential return on investments in a comprehensive urban multi-stakeholder security solution pioneered in Tampere. As a concluding part of the book, the chapter provides some closing remarks and summarizes the trademark resulting from the investment made by the city of Tampere.

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2

Envisioning the New Urban Informatics

Teija Vainio

Introduction

The technology utilized in cities has continually evolved and expanded to new domains. In the Vitruvius era, over 2000 years ago, water and sewing systems were developed, and today, sensors are delivering real-time weather information and forecasts to our mobile phones, alongside applications that assist us in moving from one place to another or aid our participation in urban development initiatives. In tandem with technology development, the impact of technology usage has rapidly transformed, with networks and devices now being ubiquitous in the daily lives of citizens, in stark contrast to the situation 30 years ago.

Technology and cities are being discussed employing the concepts of a digitalized city or smart cities. What is common among all these concepts is the integration of technology with the people using it in urban

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contexts. However, the term smart city has been criticized for being overly nebulous, as the cities have always been smart, and the strong technological orientation in the pursuit of smartness has been criticized for becoming more of a goal rather than a tool for achieving greater purposes, such as sustainability (Martin et al., 2019). The need to acknowledge the sustainable development that is connected to technology design has led to the reconceptualization of smart and sustainable cities (Martin et al., 2019), and the terms "resilient," "carbon neutral," or "resource-wise" have been employed to address sustainability issues and the objectives to tackle climate change. Simultaneously, with the emergence of techno-criticism, smart cities' inherent anthropocentrism has also been problematized. The call for a "more-than-human" smart city that takes into account the non-human aspect of the city, such as the ecosystems it is home to (Yigitcanlar et al., 2019), and has planetary-centric approaches instead of a user- or human-centric technology design (Clarke et al., 2019; Heitlinger et al., 2019; Wolff et al., 2021) is raised. A wider understanding of the impacts of technology on cities must be attained.

In this chapter, we define technology in an urban context utilizing the concept of urban informatics instead of a smart city. Emphasizing on the specific types of information collected and supplied through technology, we delve into the realm of urban informatics. Urban informatics involves the collection, analysis, and communication of behavioral data from cities and their citizens through computational methods. According to Foth et al. (2011, p. 2), urban informatics constitutes a research domain that represents the intersection of "place, technology, and people in urban environments." Furthermore, the technology in question aims to support citizens' life as technology users. Technology is utilized in urban environments for urban management and operation of systems such as waste management process, transportation, health care, and safety and security management. For example, identifying distractions in traffic flows, updating the latest pandemic situations, or having 24-hour surveillance technology in certain urban areas exemplify different types of technology usage. With the introduction of these different types of technologies, the role of the individual citizen as a technology user also varies. Citizens could either be primary users of technologies or they may simply recognize the systems and technologies but not directly interact with them, making them secondary users of technology. This notion of different roles of technology influences how technology usage is experienced (Alsos & Svanæs, 2011).

Quite often, when technology has been utilized to achieve sustainable development in cities, sustainability initiatives have been focused on technology that aims to promote the environmental or economic dimensions of sustainable development. For example, by measuring air quality (Kök et al., 2017) or energy consumption (Chui et al., 2018) or through waste management (Anagnostopoulos et al., 2017), the aim is to achieve healthy environments or efficiency in consumption and civil engineering efforts. Likewise, economic sustainability has been supported by technological advancements such as the development of blockchain technology (Xie et al., 2019). Initially, the Brundtland Commission (World Commission on Environment and Development, 1987) presented the three "pillars" of environmental, social, and economic sustainability that were defined in 2002 during the Sustainable Development Congress in Johannesburg. Subsequently, the fourth pillar of cultural sustainability was added to the discussions (Hawkes, 2001; Soini & Birkeland, 2014). So far, the clear emphasis on economic and environmental sustainability is evident, as is the lack of research on social and cultural sustainability and urban informatics.

Only quite recently, social sustainability has gained emphasis in technology development research in the urban context, with the recognition of its connection to environmental sustainability. Social sustainability has been defined by Candia et al. (2018, p. 192) as "the ability of guarantee, in the most impartial and widespread way possible, even to the weakest subjects, a good accessibility to all city functions; therefore, social sustainability implies a safe and accessible urban mobility." Accessibility to city functions and safe environments are a couple of the many aims that technology should strive to achieve for its citizens through efforts such as provision of public digital services and smart lighting in the streets. Hence, as Candia and colleagues (2018) underscored, accessibility and safety are integral components of social sustainability. This chapter focuses on the social sustainability dimension of safety and explores its connections to urban informatics.

The concept of social sustainability offers us an approach for addressing urban informatics in two ways, namely, by acknowledging the different aspects of social sustainability and by applying the aims of social equity. Boström (2012) highlighted the significance of distinguishing between substantive aspects (what to achieve) and procedural aspects (how to achieve) in the domain of social sustainability. To explain further, substantive aspects pertain to quality of life, experienced happiness, and well-being, whereas procedural aspects relate to facets such as access to existing information about risks and sustainability (ibid.). Consequently, the connections between social sustainability and urban informatics can be related to practices and avenues of sharing information, such as informing citizens with technology about possible risks to their safety to support their well-being. Furthermore, social sustainability encompasses social equity, that is, justice and fairness for all people. One approach for investigating social sustainability and urban informatics is by applying the different aspects of social equity, namely, distributional, recognitional, and procedural equity. By focusing on these three aspects in the context of safe and secure urban environments, we could analyze in further details how urban informatics can promote citizens' experienced safety and security in urban environments while concurrently aligning with the principles of sustainable development.

This chapter discusses the relationship between urban informatics, social sustainability, and safety and security issues in urban environments. We seek answers to the following question: How can urban informatics strengthen citizens' experienced security in urban environments in a socially sustainable manner? We commence by discussing the state-of-the-art-related research and then explore the possible future directions for urban informatics in the context of safety and security, with a particular focus on citizen's perspective. Subsequently, we discuss the framework in a wider context and present the conclusions.

The contributions of the presented framework in this chapter highlight key considerations for the designing of safety and security technology in an urban context and in the overall field of urban informatics with the aim of ensuring equality among citizens. The contributions of this framework are threefold. First, it facilitates an understanding of the different domains of design in safety and security technology and urban informatics concerning equality, including distributional, recognitional, and procedural equality. Second, it clarifies the areas where citizens' engagement is vital and where expertise on safety and security issues is required. Third, it highlights the importance of the different aspects of social equity in citizens' experiences of safety and security.

Connecting Urban Informatics, Social Sustainability, and Security

To gain deeper insights into the interplay between urban informatics and subjectively experienced security as an element of social sustainability, this chapter begins with an overview of urban informatics and its relationship with sustainability, followed by an exploration of the relationship between urban informatics and safety and security issues. This is succeeded by an overview of social sustainability.

Urban Informatics and Sustainability

Urban informatics concerns technology in urban environments. According to Foth et al. (2011), urban informatics constitutes a research domain situated at the intersection of "place, technology, and people in urban environments." Therefore, the relationship between technology that is situated and utilized in urban environments and the concurrent goals of sustainable development in urban environments presents possibilities. These possibilities have been recognized, for example, by the European Commission's approach to the twin transition, which integrates sustainability into digital transformation strategies and empowers organizations to work more efficiently and sustainably at the same time (see Muench et al., 2022). Therefore, the connections between technology and sustainability in urban environments have been acknowledged.

Recent research on urban informatics and sustainability empathizes with the environmental and economic dimensions of sustainability. This is evident in initiatives such as the development geospatial models that can facilitate the delineation of food access patterns (Chen et al., 2022), the investigation of strategic decision-making, the utilization of spatial optimization as a component of urban informatics (Murray & Baik, 2022), and the delineation of the applications areas of geosmartness, which involves leveraging novel spatial data sources, computational methods, and geospatial technologies (Raubal et al., 2021). In addition, studies have also been conducted on the trend of data-driven cities integrating smart and sustainable urbanism for advancing sustainability (Bibri & Krogstie, 2020).

Quite recently, particularly research on energy consumption and data supporting energy reduction have been highlighted. Garlik (2022) investigated the requirements of buildings and the need for energy sustainability, resulting in the proposal of a model for enhancing building energy efficiency. Employing computational techniques and data from health-related public sources, Varde et al. (2022) suggested a prediction tool for assessing air quality to estimate pollutant concentrations in urban settings. Moreover, Lee et al. (2021) recommended utilizing urban informatics to increase the efficiency and sustainability of waste management systems and discussed the possible pitfalls of using existing datasets for making future policy decisions.

To summarize, the current directions of urban informatics research are associated with economic and environmental dimensions of sustainability in particular. However, when using urban informatics, it is critical to ensure that we recognize the actual target groups and the ones responsible for identifying them.

Social Sustainability and Safety

Sustainability has environmental, economic, and social dimensions. These three dimensions of sustainability are intertwined, and therefore, the impact of activities that focus on one dimension extends to other dimensions as well. However, even though the relationships among these dimensions are generally assumed to be compatible, the social dimension seems to garner less attention. Furthermore, social dimensions pose particular difficulties in terms of realization and operationalization for policymakers (Boström, 2012; Colantonio & Dixon, 2010). To address this challenge, the city of Vancouver established a framework known as Vancouver's Social Development Plan (Vancouver Plan, 2022). The framework defines social sustainability through foundational principles (reconciliation, equity, and resilience) and thematic areas (climate protection and restored ecosystems, equitable housing and complete neighborhoods, and an economy that works for all). One cross-cutting topic within the plan is secure housing and spaces (see Vancouver Plan, 2022). According to Dixon (2011, p. 11), security in the context of social sustainability is defined as the state in which "individuals and communities have economic security and have confidence that they live in safe, supportive and healthy environments."

To clarify the term social sustainability, Boström (2012) examined social sustainability goals and classified them into *substantive goals (what to achieve)* and *procedural goals (how to achieve).* He categorized as substantive goals basic needs, inter- and intra-generational justice, equality of rights, and access to social infrastructure, mobility services, local services and facilities, green spaces, and the like. As procedural goals, Boström (2012) identified the following:

- access to existing and accumulated information about risks and sustainability
- facilitation of participation in the different stages of decision-making processes
- proactive stakeholder communication and consultation throughout the process
- empowerment as a result of taking part in the process
- participation in the selection of topics to be discussed and the definition of problems
- determination of solutions, monitoring of policy- and plan-making processes, and setting of standards

When looking at the procedural aspects mentioned above, the connection between information about urban environments and information related to experienced security (e.g., access to existing and accumulated information about risks and proactive stakeholder communication and consultation throughout the process) becomes evident. In addition, similarities between urban environments and human-centered technology design (e.g., empowerment as a result of participating in the process and the facilitation of participation in the different stages of decision-making processes) become apparent (see International Organization for Standardization, 2019). Quite recently, attempts to incorporate social dimensions and promote social sustainability have been made in research on urban safety and security. Candia and colleagues (2018) argued that since social sustainability is defined as the ability to guarantee good accessibility to all city functions, social sustainability bears a connection to safe and accessible urban mobility. In addition, the Organisation for Economic Co-operation and Development (OECD) indicates that urban safety and security improve quality of life, which is connected to social sustainability.

Furthermore, urban informatics and social sustainability are interconnected in their identification of data sources. Dixon (2011) presented a matrix to assess social sustainability, which involved identifying the data sources necessary for the assessments related to people, affordability, health and well-being, and sense of community. These data sources included internal data, survey data, neighborhood statistics, crime statistics, and economic and social data (ibid.). We argue that urban informatics can provide rich data despite the challenges involved.

Furthermore, Colantonio (2009, 2011) underscored that the definition of the term social sustainability is constantly and dynamically changing, depending on when and where it is referred to. In addition, the traditional measurements of social sustainability metrics, such as employment or education, are being completed with soft and less measurable concepts such as well-being, happiness and quality of life, opportunities for participation, or demographic change (ibid.). In this chapter, we turn the focus on equity between citizens.

One approach to promoting social sustainability lies in applying the principles of social equity, which we refer to here as distributional, recognitional, and procedural equity. Distributional equity signifies a fair allocation of the outcomes of material goods among all members of society (see Meerow et al., 2019; Schlosberg, 2007). In the context of urban development, this may refer to "equitable access to goods and infrastructure, environmental amenities, services, and economic opportunities," (Meerow et al., 2019, p. 797) with an emphasis of the fact that "distribution of undesirable land uses (disamenities) or pollutants across the urban environment is equally important and has long been a focus of the environmental justice scholarship and activism" (Meerow et al., 2019, p. 797). Recognitional justice refers to the equal acknowledgment of and respect extended to different identities and associated social statuses (Schlosberg, 2007). The third principle of social equity, namely, procedural equity, is closely connected to both recognitional and distributional equity. An individual's or group's membership and participation in decision-making are integral to the equitable distribution of material goods. Without procedures of recognition, an individual or group is unable to participate in the community; without such participation, their unique needs for social goods cannot be recognized either (Meerow et al., 2019). We argue that these different forms of social equity, namely, distributional, recognitional, and procedural equity, provide a solid framework for urban informatics that aims to ensure and support social sustainability development in urban environments.

Urban Informatics, Safety, and Security

In this chapter, the terms safety and security are defined as follows. Safety is the prevention of unintentional accidents, and security is the prevention of intentionally unpleasant activities by people. In the context of safety, the objective is to be shielded from accidents such as floods, fires, and traffic accidents, whereas, in the context of security, the aim is to be safeguarded from dangers such as robbery, rape, or mugging (see Candia et al., 2018). According to the new Oxford Dictionary of English (n.d.-a, -b), safety refers to the "the state of being protected from or guarded against hurt or injury; freedom from danger," whereas security is defined as the "state or condition of being or feeling secure. Freedom from care, anxiety or apprehension; absence of worry or anxiety; confidence in one's safety or well-being. Freedom from danger or threat" (ibid.). When considering urban informatics and our approach in this chapter, the experienced security of citizens and the differences between the terms safety and security are influential.

We argue that by acknowledging the different aspects of safety and security, we could utilize urban informatics accurately, and that the distinction between the two concepts is vital when considering the different stakeholders responsible for identifying and recognizing the target groups for critical information. Furthermore, the employment of technology has changed urban environments, as it enables the personalization of urban space (e.g., Green, 2019; Ratti & Claudel, 2016; Townsend, 2013), data flow, and interaction between an individual citizen and urban technological systems. All these factors influence urban informatics, sustainability, safety, and security, since urban informatics encompasses issues related to both sustainability and security issues.

Feeling safe in an urban space is a complex phenomenon. Different contextual and situational factors exert multiple impacts on one's experienced security. Contextual factors include the age and gender of those using the urban space, while situational or place-based factors, whether it is nighttime or daytime, significantly determine the extent to which age, ethnicity, or gender play out as factors affecting the feeling of safety or insecurity. Surveillance and security technology deployed in public spaces may provide a partial solution; however, even these solutions tend to be ethnicity- and gender-specific (Ball et al., 2017). In the field of security research on urban environments and urban events, security has been a focus of urban research, particularly related to urban public spaces (Ceccato et al., 2013; Klauser, 2013). Furthermore, in mass events, security has primarily been investigated from the perspective of organizers (Coaffee et al., 2011; Gordon et al., 2016; Hall et al., 2020) or the focus has been placed on the technical development of security systems (Cerny & Donahoo, 2016; Zollman et al., 2019).

A glance at the current research on urban informatics and safety and security issues makes evident the emphasis on a technology-oriented approach. In addition to citizens, visitors and tourists are quite often a target group for investigations on safeness (see e.g., Jasrotia & Gangotia, 2018; Tripathy et al., 2018). In addition, technologies such as artificial intelligence (Srivastava et al., 2017) and drones (Vattapparamban, 2016) have been investigated as tools for ensuring security. Quite recently, as a result of rapid environmental damage and impact of climate change, different types of warning systems have been developed (Barba et al., 2012; Zhang et al., 2021).

According to Sinkiene and colleagues (2012), urban safety research is currently dominated by social science theories, and different kinds of approaches are necessary to broaden the research domain. This notion is in line with Barker's view of the need for criminology and urban studies (Barker, 2017), considering safety is a fundamental component of the relationship between humans and the environment (Senda, 2015). Furthermore, Viswanath and Mehrotra (2008) argued that no single discipline can achieve the safety and security of urban public spaces and that the discourse must be located within a broader framework. They also emphasized that public participation constitutes the key issue and that the environment should be designed and built for a diverse range of users and genders.

De Silva et al. (2017) investigated urban safety by focusing on walking speed and environmental cues, outlining that people have a tendency to walk faster in areas demarcated as unsafe and that they walk faster during the night than they do during the day. Earlier, Nasar and Jones (1997) stated that the presence of people or groups of people reduce fear because busy places are perceived as areas where people would be less likely to be attacked. Phadke (2007) investigated the right to the city and its public places and social justice movements and raised the question whether security technology could be the only solution. Bengtsson (2018) highlighted the impact of spatial structure on communities and crimes. Ratnayake (2017) argued that spatial environments might influence an individual's feelings of fear and criminal behavior.

To sum up, safety and security issues constitute a component of social sustainability. Furthermore, to guarantee socially sustainable development in urban informatics and, finally, socially sustainable development in cities, the principles of social equity provide an applicable approach to achieve such development. Therefore, the principles of distributional, recognizable, and procedural equity offer a solid ground for developing urban informatics in the future with the aim of supporting citizens' experienced security.

Framing Urban Informatics into Wider Contexts of Sustainability and Experienced Security

As discussed above, urban informatics, social sustainability, safety, and security are entangled in various ways. To gain a deeper understanding of these connections, we integrate different aspects of social equity, which are underpinned by social sustainability, into urban informatics. We then reflect on these dimensions—distributional, recognitional, and procedural—within the two focused domains of urban informatics application, namely, safety and security (see Table 2.1).

Urban informatics and distributional equity aim to provide information to all equally, ensuring access to each and every individual. This

Table 2.1 Urban informatics and the aspects of social equity

	Characteristic of urban informatics in context of safety	Characteristic of urban informatics in context of security
Distributional equity	Post Ad hoc Resilience Accessibility Data literacy Media literacy Real-time Rapid changes Accuracy Support in the case of emergency	Prevention Ad hoc Accuracy Support well-being and quality of life
Recognitional equity	Coverage Critical target groups Valid data sources Recognition of responsible stakeholders Recognition of the involved parties	Coverage Recognition of responsible stakeholders
Procedural equity	Ad-hoc participatory processes Short-term structures Collaboration	Proactive participatory processes Long-term structures Collaboration

principle guarantees that access to information is ensured. Apparently, not only should devices and networks be available to all citizens but information should also be delivered in an understandable manner, for example, by using language that the reader can easily understand. The climate change experts in the latest report by IPCC (2023) highlight this aspect of language issues, arguing that in urgent cases, providing critical information in the citizens' native language is critical. In addition, ensuring proactive communication is essential. Therefore, when designing technologies such as censoring and warning systems, the urban poor, who lack access to appropriate technology, should be included in the design process.

Urban informatics and recognitional equity place emphasis on the recognition of target groups and the clarification of those who are responsible for this identification, particularly in ad-hoc situations. This responsibility is of paramount significance. In the latest IPCC report (2023), experts highlighted that even if local communities have been the target groups of urban informatics, attention should also be paid to target groups at the regional level. For example, extreme floods and wildfires usually occur in a broader area beyond the boundaries of a single local and geographically bordered community. Consequently, it is critical that the different stakeholders at the regional level have the ability and skills for collaboration.

Urban informatics and procedural equity aim to safeguard the two other social equities. In practice, this means that the structures and processes of urban informatics that are related to safety and security are designed in such a manner that the distribution of information is ensured and all the involved parties are recognized.

The distributional and recognitional aspects of social equity are quite often ensured by public authorities and are expert driven. In addition, it is typical for safety issues to be overseen by authorities, whereas security issues, along with procedural aspects of social equity, are more citizen-driven matters.

Discussion and Conclusion

This chapter discusses the connections between sustainability, security, and urban informatics from the citizens' perspective. Recognizing these connections is significant for several reasons that are connected to each other. First, the current environmental challenges, such as climate change and threat to biodiversity, are acknowledged along with their impact on citizens' everyday life. Second, as the amount of data in urban environments grows, processes and accessibility issues are addressed to ensure equality and democratic decision-making processes. Third, security is one of the domains of urban development, and part of that is subjectively experienced security, which is a component of citizens' well-being. The social dimension of sustainability is connected to equality and provides an approach for addressing related issues. Meanwhile, distributional, recognitional, and procedural processes of urban informatics present a framework for achieving the aim of ensuring the security of urban citizens through the utilization of urban data in different contexts.

The drawing of these connections between sustainability, security, and urban informatics is in alignment with earlier findings on social sustainability and smart governance of cities presented by Marsal-Llacuna (2016), who argued in favor of citizen-centeredness of city policies and local governance and underscored the need for indicators for measuring the safeguarding of citizens' rights in the city. By incorporating distributional and recognitional aspects of social equity into urban informatics, with experts shouldering responsibilities and authorities overseeing safety issues, we could facilitate social sustainability in safety issues. In the context of security issues and the procedural aspects of social equity, by adopting more citizen-driven approaches, urban informatics could promote experienced security in urban environments.

So far, a majority of urban informatics development and research has focused on environmental or economic sustainability issues rather than social sustainability. Furthermore, despite the recent attempts to shift from technology-driven to human-driven design and development in urban informatics, challenges remain. Simultaneously, the need for accurate, relevant, and valid information that is accessible and easy to understand before, during, and after the accident or incident is evident. By focusing on the characteristics of urban informatics with an emphasis on distributional, recognitional, and procedural processes and by ensuring social equity in these processes, we could enhance subjectively experienced security, which constitutes an integral component of the well-being of citizens.

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3

Watch Out: Surveilling Cities and New Outlines of Space and Time

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Introduction

In our inevitably urbanized world, cities have become the new battlegrounds characterized by the pervasive presence of technological surveillance systems and integration into a telematic topology. The proliferation of digital and communication technologies has mapped, governed, and reordered everyday experiences, flows, and practices, altering their spatial and temporal dynamics. In this chapter, drawing inspiration from the ideas of Stephen Graham and Paul Virilio, we explore how a fertile ground can be obtained for rethinking and innovating the principles and concepts of urban planning and public policies.

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The aim is not to neglect the possibilities of surveillance and security in global cities. Instead, we are engaging provocatively to guarantee that smarter engineering processes take into consideration social construction and ethical standards. These efforts could lead us to conscious approaches that instigate actions of territorial ordering and preservation of the plurality of movements and productive capacities.

New Challenges of Surveillance and the Telematic Topology of Urban Life

The world is becoming increasingly urbanized. At this juncture, life in cities has become both a product and a producer of essential technological systems. Investments in these structures are critical for ensuring that urban planning and public policy guarantee safety and security. For example, the COVID-19 pandemic has demonstrated the role played by digitally mediated forms of surveillance. In the context of insecurity, vulnerability, or risk of expansion of virus contagions, governments and businesses began to adopt technological apparatus for monitoring, mapping, predicting, and regulating their citizens. Such resources were applied to contain the spread of COVID-19 and ensure that citizens cooperate with the measures stipulated by health specialists.

As a result of the COVID-19 pandemic, mechanisms such as temperature gauges, thermal cameras, drones, biometric wearables, apps, and facial recognition software have become common. These technologies produce considerable data regarding infections, deaths, tests, vaccinations, symptom control, and quarantine periods. Couch et al. (2020) highlighted that many countries have developed specific apps for COVID-19 surveillance, utilizing the fear of death and the unpredictable to achieve control over the masses. In this context, surveillance systems have evolved into essential tools for managing fear, with the systems processing data swiftly from the most diverse databases available in the surveillance society (Virilio, 2012).

In the Anthropocene age, amid a global Ecocide scenario, these new surveillance technology applications could hold significant importance for contemporary life and its preservation. However, their impact depends on the models of society and governance that are shaping and being shaped by these technical infrastructures. The expansion of telecommunications is giving rise to a new logic of spatial organization that is specific to this new safety and security era. This phenomenon is evident in the formatting of new surveillance architectures and the establishment of complex telematic topologies (Virilio, 1991). At least two dimensions constitute a telematic topology: physical, such as placement of the various technological and material nodes of the complex surveillance system, and logical, which concerns the data flow throughout the nodes. Physically, a wide array of human and machinic elements interact within the nodes that constitute the technological security systems. Logically, there exists a rational structure governing the operation of these systems, which encompasses the conception and the reasoning informing the flows of data and information within the technical and political architecture. Specifically, these dimensions constitute the telematic topology of urban environments.

In our surveillance culture, it is not just the state that wields vigilance power; civilian devices also transform into nodes for monitoring and observing people's movements and practices. As our daily routines are no longer limited to cities' material spaces or territories, security policies and regulations have penetrated global networks' dromological and telematic spaces. This is evident in various scenarios, including the data flows generated by individuals making online purchases or engaging in negotiations using messaging apps and the digital actions of governments, companies, and educational institutions.

Implementing robust surveillance systems has modified the urban space and altered the temporal dynamics of cities, accelerating witnessing through telematic mechanisms. The time between the occurrence of an event and its visualization or identification through the images is rapidly diminishing. The speed awarded by technological innovations in surveillance is leading to a transformation of time into real-time. Considering these aspects and the collaboration between multiple actors, democratic processes for implementing surveillance projects could achieve socio-economic efficiency. The chapters in this volume demonstrate how incorporating socio-technological interface and human capital in strategies ensures the performance and resilience of surveillance systems.

Rethinking Surveillance from Graham and Virilio's Perspectives

Stephen Graham and Paul Virilio provoke crucial reflections on the militarization of everyday life. Graham (2011) demonstrated how military and security forces perceive all urban territories as conflict zones inhabited by potential enemies. Therefore, populations or citizens are controlled, scanned, and tracked. Drawing from the concepts well developed by Michel Foucault, these practices of observing, punishing, and controlling are enhanced by employing digital and communication technologies that modify urban spaces. Kitchin (2014) corroborated what Graham (2011) established by arguing that, in the digital age, machines created by military technology, such as the Internet, influence public space administration.

Beyond control over borders with the outside world, Graham (2011) unveiled what he termed the new military urbanism. In this paradigm, military and security practices began to permeate the entire urban fabric, guided by discourses on war on terror, trafficking, vandalism, protests, and activist practices. This new military urbanism has the following five key characteristics: the urbanization of security, Foucault's boomerang,[1] surveillant economy, urban infrastructure, and citizen soldiers. Each of these characteristics constitutes the foundation of a systematic process within contemporary cities.

The urbanization of security alludes to tracking and screening techniques to identify possible threats to social order. It ranges from controlling the great masses on the Internet through GPS, overseeing global

[1] Foucault's concept of boomerang concerns the interrelation between military and security doctrines that are traditionally present in colonial peripheries or the Global South but return to and are implemented similarly in colonizing cities or the Global North (Graham, 2013). For example, the reproduction of Israeli population control tactics in cities across the United States and Europe. For more: https://www.opendemocracy.net/en/opensecurity/foucaults-boomerang-new-military-urbanism/

tourism, and even extending control over infrastructure such as port lines, post offices, and the electrical grid. Graham (2011) claimed that these systems constitute the primary components of what would entail a "colonisation of urban spaces" and that this control is viewed by many as the best way to combat "Asymmetric" or "Irregular" Wars. Virilio and Lotringer (2008) argued that technology's omnipresence, which is driven by its speed, transforms all potential places into tangible spaces of its power. Paul Virilio stated that this moment represents a *Pure War*. War is no longer localized in the military realm but has infiltrated all spheres of society. Wars are not limited to battlefields anymore; they are now also between urban communities. The emergence of the new militarism phenomenon and its dromological consequences does not exclude the possibilities of war in the old and barbarian ways. Instead, it extends military tactics and strategies to a multitude of urban places and spaces. In other words, the battlefields are now bars, parks, schools, highways, squares, and streets—environments familiar to the urban population. The recent attacks on schools in Brazil present a fitting example, similar to what happens more frequently in the Global North.

These wars are considerably unlimited and not restricted to a specific environment. They are permanent with no conclusion in sight. Militarization acts in and for the cities, generating profiles of individuals, groups, associations, places, and behaviors. The securitization of urban centers involves the imitation and dissemination of technologies initially tested in war zones. Boyle and Haggerty (2009) underscored that urban securitization became legitimized after the 9/11 attacks. For example, FIFA and the Olympic Committee have turned their events into a spectacle of security technologies, commanding the host city to invest much money in surveillance and urban securitization. For more details about this relation, see Chaps. 7 and 13.

Foucault's Boomerang effect materializes through security practices implemented in urban and metropolitan centers through mechanisms of power and control. The utilization of drones and geolocation tracking, typical in conflicts across the Middle East, is now frequent in cities of the Global North and South. Technological devices and military tactics and strategies are components of city planning and management. Military strategies may be tested in inhospitable or desert territories, but they tend to be applied in urban areas. The suicide or kamikaze drones employed by the Russian army in Kharkiv illustrate this reality. This bomb-adapted drone is commonly utilized in conflicts in war zones such as Iraq and by the Islamic State. Foucault's boomerang notion involves urban planning and policies importing or appropriating techniques and strategies designed for ensuring security.

The construction of a surveillance society in the manner of what we have been calling new military urbanism does not happen suddenly. Instead, it is a continuous and, to some degree, a precarious process of articulation and interconnection between human and non-human elements that constitute a constellation of surveillance systems. The police adoption of body cameras due to controversial racial and gendered deaths by officers (Joh, 2016), the securitization of urban spaces through the use of Automatic Number Plate Recognition and DNA databases (Pieri, 2014), and the utilization of drones and GPS technologies in urban space surveillance (Jensen, 2016) are just some examples of how apparent isolated policies and practices build constellations of safety and security systems.

The third characteristic delineated by Graham highlights market and economic participation that embeds new military urbanism into the spheres of surveillant capitalism. As stated before, technological surveillance systems depend on allied capitalists. These could be specialized industries, surveillance industry, universities, laboratories that invest in research, and even the entertainment industry that reinforces the discourses of safety and security.

Graham (2011) underscored that the security market is expanding in response to the growing amount of invested capital, the rising number of multinationals selling militarized techniques, and even the rise in state support. For example, the CCTV market has expanded enormously in the last two decades. Persistence Market Research Report indicated that the CCTV market moves around US$14.7 billion a year (Persistence Market, 2022). The security market sustains itself by primarily depending on the action of "global cities," that is, metropolises in the countries of the Global South in particular that exercise significant international influence and have considerable economic prowess.

Financial centers govern the militarization of cities, serving as hosts to military headquarters and supporting research into new militarization techniques, in addition to sustaining the security market network. European Union (EU) countries have even invested in creating local companies focused on these tactics to generate market competition and leverage the economy. However, unlike others such as the United States, China, and Brazil, the EU has more restrictive rules pertaining to ethics and AI. In Nordic countries especially, massive efforts have been invested toward guaranteeing privacy. For instance, the SURE project employed military technologies such as CCTV, set up a command and control room, and created an AI application to identify disruptive behavior in specific areas in the city of Tampere. However, these efforts were made with a commitment to preserving privacy, maintaining institutional trust, and safeguarding the rights of citizens. SURE enhances the safety and security of residents and tourists in Tampere by developing and implementing a comprehensive and intelligent urban security solution focused on events (SURE, 2023).

In the context of urban infrastructure, Graham (2011) considered the dependence of urban spaces on a complex technological network as dangerous, for this dependence could create another war in these spaces. Regarding this, state and non-state actors leverage this dependence to boost violence and urban warfare, in addition to employing it as a means of political coercion. In this manner, non-state actors manage to sabotage electrical networks, broadband Internet systems, and water supplies. They demonstrate the vulnerability of urban spaces to complex infrastructural interventions. Furthermore, it is possible to transform such common elements into lethal weapons in this war scenario.

In the face of attacks on basic infrastructure, Elon Musk's SpaceX company gained prominence in the Ukraine and Russian War by providing Internet connection services to Ukrainians through Starlink. The heightened complexity of wars or conflicts is closely linked to a direct dependence on technological information systems, especially visual information systems that ensure the verification of targets and the assessment of attack outcomes. In the early twenty-first-century conflicts, we see a practical refinement of these ideas.

The last characteristic that Graham (2011) attributed to new military urbanism seeks to explain that it is legitimized in society and veiled in entertainment and the urban, electronic, and material cultures. There exists, therefore, a collective search for security through the intersections of civil and military domains. The streets and other urban spaces have become permanent film sets (Virilio, 2009). Cameras of civil phones, drones, action cams, and private security systems dominate cities. In this context, citizens become soldiers in the struggle to defend their towns as a built physical space as well as their identity and cultural base.

The process of citizens becoming soldiers presents itself in different forms depending on the level of analysis and the phenomenon in question. From the global and broad urban perspective, citizens become more vigilant of the threats and "enemies" concretely or discursively in everyday practices. However, as mentioned before, there is still space for traditional and barbarian wars that subjugate territories, identities, and the existence of societies. In this context, citizens became soldiers as a part of a military force.

The increasing improvement of the military-technological complex has engendered a significant distance between the soldier and his target. Drones that monitor territories in conflict or under threat and launch attacks against enemies illustrate this phenomenon. In the context of the Ukrainian war, media discourse on combat strategies defined drone images as fundamental tools of persuasion or dissuasion. Cameras that were previously utilized for conducting and monitoring tourist tours, for example, on the Eiffel Tower or in the region of Chornobyl, were converted into a form of surveillance and alert system. In the relationship between war and cinema, according to Virilio (2009), images became elements of organization and mobilization for the conflict. We currently have a military-industrial-media complex—a war machine that involves the war economy and its representation through images.

Political and Ethical Aspects of Mapping, Governing, and Reordering Space and Time

Our everyday practices have become the fulcrum of attention in the surveillance society. The monitoring, controlling, and disciplining of individuals' practices, intertwined within a network of both human and non-human elements, permeates the space and time dynamics of cities, giving rise to a telematic topology. Aspects such as these demand ethical considerations pertaining to freedom, autonomy, and citizenship. What are the limits of these issues when formulating public surveillance policies and deploying technological control and discipline systems?

At the public management level, we must consider how surveillance is imagined and experienced in the more mundane activities of urban spaces. This entails a thorough consideration of the different moments of *dynamis* and *stasis* of individuals (e.g., walking, sitting, running, jumping, screaming, and swimming) and the various places and non-places (e.g., subway, buses, airports, malls, schools, and roads) that constitute cities.

Following technological developments and their enchantments, people have become familiar with and even collaborate with surveillance processes. In a manner akin to biopower, bodies assess the acceptable or unacceptable behavior of others. This intertwining of formal and informal surveillance leads to one complementing the other in a constitutive ecosystem of the telematics topology. The surveillance culture, then, depends on more than just public policies but hinges on engaging individuals in the continuous and ubiquitous exercise of what Foucault (1995) refers to as the microphysics of power. Lyon (1994) argued that power, as Foucault describes, has in this new culture two main aspects that are focused on information and data collection.

The surveillance society, driven by technological flows, is characterized by a series of new rationalities of power and the deterritorialization of both bodies and capital, reshaping how different forms of knowledge about the population through almost complete reliance on protocols, numbers, and codes. The Privacy International Report (2017) argued that technologies have ushered in a new form of authority over the body, wherein several corporations and governments share power. Data, as a collective entity, has assumed a pivotal role, with numbers and, more recently, algorithms structuring life.

With novel communication technologies, a new era of surveillance began with the expansion of privatized and commercialized surveillance. The discipline theory developed by Foucault no longer provides a sufficient answer for the current society. This dominance of surveillance technologies began being challenged by other authors, as there are now questions that the panopticon cannot answer or even address. Authors of late modernity, such as Lyon (2005, 2007), Bogard (1996), Haggerty and Ericson (2000), and Graham and Murakami Wood (2003), developed the school of thought known as post-panoptic. These theorists raised critical questions regarding the nature and implications of the surveillance and control society. How do the digital revolution and advancements in technology shape post-panoptic surveillance? What are its ethical implications? Are there alternative modes of ensuring safety and security emerging in the post-panoptic era?

In this context, citizens become guardians of public order and collective interests. Many individuals consciously adopt such stances; however, as Lyon warns in his book, *The Culture of Surveillance*, the vast majority act unconsciously. The utilization of surveillance mechanisms in urban spaces has intensified in the face of constant threats from the actions of terrorists and criminals and the worsening of weather events that endanger both the safety of people and the integrity of technological infrastructure. Surveillance instruments or mechanisms have become a given within the scope of citizens and their relationships with others.

The growing recognition of systemic threats and risks has brought with it an awareness of their unpredictability and highlighted the need for equally complex mechanisms to manage the unpredictable. From this perspective, Beck (1992) argued that the risk society is ironic. For the author, technological systems attempt to anticipate the unforeseen. If that were possible, the most significant military power in the world would not have suffered a terrorist attack in the heart of one of its most important cities. The logic of a risk city is informed by unpredictable, such that experience cannot predict future actions. Instead, public surveillance policies could seek to minimize its negative impacts on society (Beck, 2006).

As a result of the threat/risk potential and the current circumstances of excessive fear and insecurity, popular demand for new surveillance systems is on the rise (Haggerty & Ericson, 2000). As a result, these systems are popularized (Virilio, 2006). The use of chips, digital tags, geolocation, chats, Internet banking, social networks, search applications, and maps, among others, is now normalized. At the level of safety and security services, control is established through drones, cameras distributed throughout the territory, satellites, radars, and biometrical gauges. In this sense, Godoy (2012) argued that incorporating technology has produced knowledge and truths about a given population in an increasingly fluid and fast manner, rendering speed critical.

In the context of surveillance policies, the acts of looking and listening demand a more specific reflection and debate, especially about the "goodness" or "badness" of employing surveillance technologies. Drones, for example, are present in civil, military, and political societies. In the war between Ukraine and Russia, we have witnessed the participation of civilian volunteers in using their drones to monitor Russian troop movements[2] or drop hand grenades against enemy forces. In coups such as those that occurred recently at the US Capitol and the headquarters of the judicial, legislative, and executive powers in Brazil, drones facilitated the facial recognition of those involved in the attacks. The moral qualification of the drone's applications as a monitoring and control instrument and that of many other surveillance technologies raise philosophical concerns that demand in-depth reflections and studies.

The denaturalization of surveillance culture is vital in building or shaping telematic topology in a collective, participatory, and conscious manner. Furthermore, consider the two concepts presented by Lyon (2018). The *surveillance imaginaries* represent the meanings and understandings pertaining to the visibility of everyday life and its shared expectations and regulations. The *surveillance practices* in the concrete daily life of cities contribute to the (re)production of imaginaries.

Watching and being watched in the surveillance culture is likely linked to ethical foundations for building and preserving civilized and

[2] For details, see the Washington Post: https://www.washingtonpost.com/world/2022/12/02/drones-russia-ukraine-air-war/ and BBC News: https://www.youtube.com/watch?v=f6XXKxogbUk

egalitarian societies. Therefore, we must avoid commodifying data and information concerning urban imaginaries and practices. The urban planning and public policies of safety and surveillance must consider the emerging new ways of imagining and engaging with surveillance practices on the basis of data justice, digital citizen participation, and the goal of the common good.

This paradox between the potential benefits and risks of adopting technological surveillance systems affects our imaginations and everyday practices. In this manner, public policies must move toward participatory processes and collective construction and seek to minimize the sociocultural and political externalities of its implementation.

Different interests serve as drivers for the adoption of surveillance technologies. Some significant motifs are interesting to note in the context of communication, interaction on social media, debates about social justice, or simply an interest in having fun. We relinquish part of our total freedom when we decide to live in society. We have come to renounce part of our privacy by promoting ourselves publicly and transparently through social media. In this telematic conjuncture, the public and private are constantly evolving.

Public policies could take into account the plurality of desires and experiences that constitute the urban environment. Telematic topologies must embrace ethical nuances and radically consider the diverse interests of citizens, not the other way around. Additionally, we must problematize and defy the racialization of surveillance, especially in the context of algorithms. We must avoid authoritarian regimes that can benefit from technological surveillance systems established during critical events such as 9/11 and the COVID-19 pandemic.

What Is the Future of Safety and Security?

As indicated throughout the chapter, urban spaces and their temporalities are continually evolving due to the accelerated advancement of technological systems that permeate and constitute life in society. This surveillance culture and economy has molded our imaginaries and practices. The emergence of new visible and invisible, predictable and unpredictable, threats necessitates an ongoing reflection from the state, companies, and civil society on issues such as regulation, legislation, protection, privacy, freedom, segregation, and isolation.

Surveillance policies and their applications have become a constitutive component of the functioning of contemporary cities. In addition to the provision of electricity, water, gas, and Internet services, we also have an assurance of safety and security. In this manner, different sectors of society must dedicate themselves to participatory debate and planning to minimize possible externalities. Surveillance studies could address new issues or explore approaches to thinking critically about the challenges and potentials associated with the securitization of the Global South and North.

The unforeseen future of urban safety and security depends directly on our actions. The SURE project represents one good example of how citizens' protection can be guaranteed while simultaneously utilizing military technologies. We must remain vigilant in the planning, organization, and development of cities and social structures that we wish to leave as legacies for future generations.

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4

People, City, and Security: Urban Interfaces in the Age of Events

Ilari Karppi and Iina Sankala

Introduction

"Secure is the new sustainable." Cities worldwide brand themselves with trendy concepts that, with continued use and industrious iterations, soon lose their distinctiveness and turn bland, thus calling for rebranding efforts with new labels to rejuvenate their image. Indeed, cities have been "sustainable," "informational," "connected," "smart," and "creative" to a degree that makes it tempting to envision a humankind that has happily rid itself of a good deal of its troubles.

When discussing cities and their planning, we are, in essence, engaging with the scale of the entire humankind. Homo sapiens are a predominantly urban species. The *Anthropocene*, an epoch in the geologic timescale significantly shaped by human impact, is prominently manifest in what Robert Beauregard (2018; cf. Latour, 2014) approached in his critical account as the *Urban Age*. Beauregard claimed that many of the

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gravest problems that humanity faces take their tangible and material shape in cities. Therefore, an equal tangibility should also be required from solutions to these problems. At the very least, these solutions should acknowledge and be compatible with the demands inherent in *urban spaces*.

As the generic expression "urban space" has been widely used in this entire volume, it is worthwhile to lightly dissect it. It includes, at least:

1. *Urban places* that are distinct from other places, meaningful and legible to individual urban dwellers, often sources of identity, and well recognizable and territorially compact;
2. *Urban tissues* that are jointly produced by the diverse uses of and interactions between urban places, enabled by connecting streets or other grids; and
3. *Urban environments* that encompass wider systems of green and blue structures that mingle with built environments, various hardscapes, urban objects, and artifacts. These environments are typically recognized as culturally created habitats for humans, non-human entities, and, in the age of artificial intelligence, progressively inanimate things.

In research, notions of both "secure cities" and "sustainable urbanism" should be approached with a pinch of salt. Rather than being strictly defined concepts, they are more like expressions denoting certain desirable state of affairs. While it is at least heuristically possible to distinguish elements and behaviors that explicitly render things unsecure, unsustainable, harmful, or detestable, the opposite is often significantly more challenging. By declaring, "My sustainability is not your sustainability," Janne Hukkinen (2000, p. 175) aptly captured one of the key problems in promoting something that is generally deemed desirable, but with numerous overlapping manifestations and implications. "Planning sustainability" is considerably more challenging, if not a complete castle in the air (Karppi & Vakkuri, 2020, p. 757).

From the vantage point of this simple heuristics, the security–sustainability nexus is relatively easy to grasp. Urban life that cannot be perceived as "secure" or "safe" can hardly be deemed "sustainable" (cf. Karppi & Sankala, 2021b). Yet, this signification is not that simple. Maximizing the authorization and deployment of security-producing mechanisms at all costs and sidelining social endeavors aside would imminently endanger sustainability of any population and settled space, urban or not. Thus, sustainability and security share a common frame or "platform" of urbanity. They both are plausible and even desirable goals in their own right, yet their mutual relationship is far from being free of the complications that obviously reflect or even stem from their inner complexities. These complications have been unfolding in cities for decades and centuries, and their era is anything but over (e.g., Gualini et al., 2015).

In this chapter and within the purview of the SURE project, the urban spaces particularly at stake are those that surround various event venues and arenas. They can be understood as *interfaces* through which events interact with life in the cities that host them. The preferred locations for twenty-first-century mega venues are typically situated in downtown areas where they spatially and functionally integrate with other urban areas and their uses. This means that the events no longer radiate to but effectively *permeate into* the surrounding city life. In practice, these venues often lay claim to streets and squares, formally designating them as *fan zones* or decorating them thematically to commemorate events such as ice hockey tournaments or jazz festivals, to cite just a couple of examples. One may say in the classical terms of Jane Jacobs (1961) that these venues bring myriad extra eyes to the streets, thus enhancing their security. However, the gaze of these eyes is different from that of regular city dwellers (cf. Urry, 1990).

Three distinct planning issues can thus be identified when sustainability and security are entwined in an urban setting:

1. Event venues as urban places: How do we plan institutional strategies that can enhance our capacities to develop safe and secure event cities?
2. Securing event spaces in a sustainable manner: What should be required from different venues' interfaces with the surrounding urban tissues to prevent them, at least temporarily, from compromising the security of the urban space?
3. Grasping the key characteristics of secure event spaces in a sustainable city: Is it possible to plan for security and venues simultaneously,

considering the specific role of event spaces within the wider system of urban environments?

This chapter discusses findings from Tampere, Finland. Tampere today is the core of Finland's second-largest urban region and a hallmark of successful post-industrial transformation, where event arenas have replaced old smokestacks as signifiers of the city's vitality. In the past decades, the expansion of the event economy has closely paralleled the city's urban transformation, which includes large-scale infrastructure projects and major infill developments (e.g., Valkama et al., 2020). Many of these high-profile projects have received attention both nationally and even globally. Backed by annual rankings, the city can easily promote itself as the most attractive city of the happiest country in the world (Begley Bloom, 2022; Helliwell et al., 2022). With the recent SURE-related investments and growing interest in smart urban security solutions, the city aims to gain a competitive advantage for also being the *safest* place to live and arrange major cultural or sporting events in particular.

The pace of this change is, however, not welcomed by everyone. Over the past few years, various spillover effects of mega-events, along with disruption from the construction sites of large urban development projects in Tampere, have disturbed and caused concern among local dwellers. The effects of new modes of transportation and sudden roadblocks or massive people flow can mitigate locals' experienced safety if the changes occur without clear communication and adequate citizen involvement. The role and utility of technology in producing security also requires careful consideration and social acceptance, whether it is for securing specific events and their venues or setting up surveillance equipment for monitoring public urban spaces.

This chapter explores the evolution of security thinking and ways of planning secure cities that have developed over time. It discusses new forms of urban competition and how the event industry and its security regimes have affected urban planning, creating new technical and spatial interfaces. The framework provided by previous literature is discussed, along with findings pertaining to the case of Tampere.

Security and Planning in Cities: From Exclusion to Inclusion

The feeling of safety is a fundamental aspect of quality of life in cities. Concern for safety and security and the tangible measures that follow to ensure the same are clearly evident in the history of human settlements. The practice of utilizing design for securing cities and traffic connections that link them can be traced to the Middle Ages and are even conspicuous in the earliest fortifications. However, the proper idea of *intervening in the processes of urban development* and *regulating urban form* is firmly entrenched in the origination of the industrial era.

The role of built environments is well acknowledged in crime prevention. Reduced opportunities for crime constitute the most widely employed concept in this field. The approach of crime prevention through environmental design (CPTED) was originally developed by Ray Jeffery in his eponymous 1971 book. However, as Jeffery (2000) himself remarked, in the 1970s, it was not CPTED but Oscar Newman's ideas of *defensible space* presented in 1972 that became widely welcomed by the US federal government and within corporate spheres. Newman's ideas emphasized territoriality, surveillance, and access control (cf. Newman, 1996), which as issues and phenomena are well acknowledged in the SURE agenda.

Jeffery (ibid.) emphasized the ecological aspects of CPTED, highlighting how individuals interact with the physical environment using their cognitive faculties. In practice, however, CPTED appears in a remarkably cruder light. According to Cozens and Love (2015), this approach is utilized for minimizing criminal activity through increased surveillance and target hardening, making potential targets less vulnerable to damage.

Newman's vision of creating "defensible spaces" includes elements that aim at building communities that assume the responsibility of maintaining order and surveillance in specific areas, such as neighborhoods (Cozens & Love, 2015). Defining these areas or turning generic spaces to meaningful places (cf. Ellard, 2015) can be supported with physical or symbolic boundaries that denote the difference between public and private realms. According to Cozens and Love (2015), CPTED has transitioned from the realm of architecture to urban planning by addressing issues such as lighting, visibility, guidance, and mixed-use development. While all these efforts support citizens' experienced safety, they do not necessarily stem from an explicit urge to merely "plan by the CPTED playbook." As Minnery and Lim (2005) explained, many of the CPTED features should be components of a regular good design.

Earliest design-related solutions (CPTED or defensible spaces) for securing urban environments in US cities focused on residential areas, particularly "blighted" public housing projects that were visibly suffering from poverty and lack of opportunities (cf. Jacobs, 1961; Moskowitz, 2018). Moreover, many of them were (and still are) disadvantageously located in the immediate vicinity of arterial thoroughfares or other sources of detrimental emissions. Yet, these factors were largely neglected in the attempts to study the projects' design from the security perspective, with the focus placed on the heights of the buildings or clear visibility of the paths and routes within the project premises.

While these environmental qualities were well recognized in the writings of classical urbanists such as Jane Jacobs, Louis Wirth, and Camillo Sitte, it became evident by the early 1970s that design alone couldn't effectively address problems with societal origins. The 1971 detonation of the gigantic Pruitt-Igoe housing project in St. Louis still lingers as a warning sign for all urban planners to not to resort to design for mending flaws that do not have bad design as their root cause (cf. Kunstler, 1994). They require other, people-centered, and socially responsible approaches, policies, and methods.

While the first-generation CPTED counted on physical elements such as "locks and gates" to empower residents in securitizing their neighborhoods, second-generation CPTED approached things differently. From the late 1990s onward, social aspects and community building have become key elements in security planning. Solutions include residents' participation in promoting their own safety and provision of support for fostering social cohesion and inclusivity (cf. Hill Coletrane, 2011). Local events, festivals that celebrate the community's sense of place, and community gardening are all components of this approach (Cozens & Love, 2015; cf. Winston, 2010).

This generational shift followed squarely the increased importance of broader public participation and the knowledge derived from it received within planning theory and urban development practices—a phenomenon best known as the "communicative turn in planning" (Healey, 1997, pp. 29–30). This new introduction of citizen engagement has been formalized in Western planning legislation, even if the increasingly complex social, ecological, and technical circumstances that planning agencies encounter regularly reveal its deficiencies (Leino et al., 2017). At the same time, it is crucial to consider that urban planning is a complex field involving specialized professionals with focused perspectives on their distinct roles that collectively drive planning, decision-making, and, eventually, implementation (Beauregard, 2012, 2015).

However, this shift signifies a virtual revolution in urban planning. With this change, planning finally gained a foundation within *planning theory itself* that enabled it to depart from a long tradition of relying on "maestros"—the figureheads of the planning profession, who, since as early as the 1920s, under the auspices of CIAM (International Congress of Modern Architecture), had determined what would be the correct method of planning and designing cities. This design orthodoxy thus established the decree that different urban functions, including residential, work, retail, and recreation, should be kept spatially separated. CIAM was formally disbanded by the 1960s and the rigidity of its planning principles gradually began to loosen. Yet, they remained influential until the mid-1980s. Afterward, resistance from within the planning profession itself—first in the guise of Neotraditionalism and later New Urbanism—advocated for a return to more closely knit forms of urbanity (Ellin, 1996; Graham, 2016).

What followed entailed mounting requirements for a more mixed use of urban spaces. Particularly in the USA but also elsewhere, urban morphology dissipated into an automobile-led sprawl that extended the separation of functions across regions featuring business parks, suburbs dominated by automobiles, and strip malls—all of which were connected by regularly congested traffic (Jessen & Roost, 2015). In the 2010s, this structure became the object of increasing criticism on both ecological and socio-economic grounds (Chakrabarti, 2013; Montgomery, 2015). For a plethora of reasons ranging from the ripple effects of the 2008 financial crisis to the rise of new cultural patterns that led to the revitalization if not an outright renaissance of inner-city neighborhoods, a simultaneous countertrend to the ongoing suburban sprawl in American cities started to gain prominence (Ehrenhalt, 2012). Furthermore, new transit-oriented ideas of urban development favored planning of walkable mixed-use urban hubs along the transit routes.

Many of these trends are also visible in Finland and certainly in Tampere. With the implementation of a new light rail system (LRT) and heavy investments in event venues, in addition to what can be described as leisure infrastructure (cf. Chakrabarti, 2013, pp. 155–157), Tampere exhibits many of the features associated with the urban age (Beauregard, 2018). Unfortunately, this also includes gentrification due to the increased desirability of inner-city neighborhoods and investments along the LRT routes—a pattern that is globally recognizable (Karppi & Sankala, 2021a; Moskowitz, 2018).

Tampere's positive image has attracted both domestic and international migrants to the city. Together with the growing experience economy, which is evident in various large-scale festivals and sporting events, this change has also changed local dwellers' everyday life in unprecedented ways. The vibrant urban life of a small but nascent metropolis inflicts innate side effects such as disruptive behavior and substance abuse. According to a 2021 Safety Survey of the City of Tampere, these ramifications have, to some extent, increased the locals' experienced insecurity, particularly in the downtown area (City of Tampere, 2021). Effects of the rising experience economy and their inevitable implications for planned security in Tampere are further discussed in the chapter.

Event Arenas as "New Smokestacks" of a Competitive Post-industrial City

Similar to smokestacks of the industrial era, event arenas are visible embodiments of the transformation of Tampere from an industrial to a post-industrial city (cf. Mehan, 2019). This transformation both resembles and remarkably differs from that of many other mid-sized manufacturing cities worldwide. The transition from industrial production to knowledge production and services constitutes a global and generic phenomenon that is intertwined with heightened city competition. Its key instruments include digitalization and a constant pursuit of higher productivity. However, this shift can also result in unwanted consequences such as steepening societal polarization and greater income inequalities.

All of these elements are features of what Brynjolfsson and McAfee (2016) refer to as *The Second Machine Age*. However, localities differ in terms of their capacities to adjust to this transformation, which is discernible even in the physical cityscape. Old factories in downtown locations may be turned into startup hubs and offices, or they may be abandoned and possibly repurposed for unexpected uses (cf. Mameli et al., 2018; Savini & Salet, 2017).

To succeed in this transformation, cities compete for new kinds of "talents," and to attract this resource they need to invest in the quality of urban spaces and their amenities. Brynjolfsson and McAfee (2016) are clear on this point: Excellent infrastructures create productive and pleasant places for living. In their view, competitive locations can be planned, designed, and constructed, and a crucial aspect of a city's vitality involves doing so for attracting events, visitors, and event-related services. This process is clearly connected to digitalization and related "machine age features." The construction of new venues and infrastructures for new event industries is regularly perceived as a key driver for introducing and deploying integrated technologies for managing urban spaces that are also in a state of transformation (cf. Coaffee & Fussey, 2011).

Tampere and its cityscape have changed and are still undergoing transformation at an unprecedented speed. The city development projects include further extensions to the LRT system, heavy urban infill noticeable in old brownfield sites, and construction of new event venues such as the 15,000-seat multi-purpose arena, which is one of Europe's most recent. These venues are peculiar embodiments of the city's strategic goal to strengthen the local experience economy and creative industries. Events serve this goal both on their own and through various encounters and interactions as they permeate the surrounding urban space. However, the ripple effects of this transformation can be noticed in many forms, and to secure the transformation's legitimacy, tangible measures are required to ensure that the events do not risk the citizens' experience of a safe, livable, or smoothly functioning city (cf. Rothman, 2006; Karppi & Sankala, 2021a, b; Ehrenhalt, 2012).

Event arenas are also tangible urban objects. They are high-profile infrastructures and technological assemblages that require heavy investments and meticulous operation and maintenance. Both arena infrastructures and the performative processes they host need to be monitored and protected against any conceivable threats, ranging from harsh weather conditions and technical glitches to terrorism. The same applies to the performer, guest, and spectator flows. Thus, an old industrial city replacing smokestacks with event arenas both entails and requires new approaches to surveillance, with consequences that cross the event venue limits and seep into the surrounding city. This process goes hand in hand with increasing generic changes in urban life. All of these changes ultimately lead to a newly resuscitated interest in urban open spaces (Ottone & Cocci Grifoni, 2017). Following the Second World War, these spaces, along with other parts of the urban tissues typically found in downtown areas, were largely abandoned by the affluent middle-class population owing to this demographic's fabled "flight to the suburbs" (Ehrenhalt, 2012).

Now, with the inner-city renaissance at hand, particularly in an event city, the newly vibrant open urban spaces assume a pivotal role in the financial circulation of the local economy. However, while event guests can be largely credited for this financial boost, their role as community builders in the spirit of the later-generation CPTED (see above) is questionable: Only a fraction of them are permanent dwellers of places influenced by the event venues. Therefore, it remains appropriate to rely on the combination of traditional and more advanced means for keeping these areas of the urban tissue secure. The advanced means include surveillance systems extending from the event venues to the surrounding urban space, with a task force to protect these areas as connected spheres of value creation. These systems comprise an entire ecosystem of integrated cameras, various sensors, lightning, information screens, and wayfinding systems—all of which are powered through learning algorithms and operated through IoT platforms and digital twins.

Security concerns challenge the utilities and availability of urban spaces. Furthermore, event arenas are often springboards for introducing new security technologies and security protocols to the surrounding urban spaces, often without any public debate or deliberation that otherwise awards legitimacy to urban planning processes (Boyle & Haggerty, 2009). Within the Tampere City Hall, security is closely connected to the development of urban environments. It is considered central to the fierce, often global, competition for the hosting of large-scale events. A distinctive feature of Tampere that enables the city to attract these events is the combination of close-knit cooperation among authorities and the deployment of smart technologies in urban spaces. The city's security director describes security's strategic role as follows:

> The city takes security seriously. The new city strategy emphasizes the role of security and safety: The goal is that they should be present in all urban development. For example, in the Five Star City-Center development program, security is one of the strategic priorities. In the security plan of the City of Tampere, the development of event security is its own area, and the plan is constantly updated. Taking care of event safety both inside and in the surrounding areas is a criterion for obtaining event permits for the organizer. For example, there is a constant discussion with the police about the boundaries of the law enforcement officers' domain. (Risk management and security director, City of Tampere)

As the city transforms, so do the roles and even the constitution of the community of security actors tasked and authorized with keeping the city secure. They include law enforcement and safety agencies, police, fire and rescue departments, first responders, emergency response center, social stand-by service, and the city's urban security unit. Moreover, and importantly, these actors are accompanied in this task by an array of private entities ranging from technology companies to security guards. The post-industrial transition has transformed the traditional firefighting ecosystem, with direct implications for the role and profile of the fire department. With the shutting down of traditional industrial plants, their industrial fire brigades with specialized capabilities in handling respective industry-specific hazards have also been disbanded. Conversely, new event venues surrounded by equally new high-rise residential and office complexes, or massive stadium concerts in downtown areas, now pose new kinds of challenges and requirements pertaining to their approach, equipment, and, necessarily, partnerships.

Law enforcement undergoes transformations in response to these changes. The fast-expanding event economy evokes fluctuations in the resident and non-resident population, particularly in the downtown locations close to event venues. Event guests vary from one event to another, spanning a wide range from chamber music festivals to international soccer qualifying games, each of which require entirely different contingency plans. Simultaneously, another transformation is taking place, and as a local manifestation of the global urbanization megatrend, it is even more fundamental (Beauregard, 2018). Large-scale construction projects are indicative of the seemingly persistent population growth in Tampere. This exerts dramatic impacts on the cityscape, contributes to the city's overall transformation, and further complicates the evolving urban security scene.

To offer a comprehensive view of this security transformation, we ran a series of workshops and simulations (cf. Karppi et al. in this volume) with the Tampere security actors (Table 4.1). In addition to the authorities and agencies discussed above, we also involved event organizers and their security staff as vital co-producers of security. In the workshops, we drafted security scenarios for four actual event venues or environments and analyzed in collaboration with the participants their relevance and accuracy as well as the potential merits of different security and surveillance technologies. Two of these scenarios were then selected for further processing, and manuscripts for the simulations were written in collaboration with the security actors. Some of the technological solutions presented in the workshops were then deployed and tested in the simulations.

In the next section, we present in further detail how "the event city Tampere" is composed of several different event spaces and arenas that (1) facilitate different uses and thus (2) encounter different safety and security risks, similar to those identified by law enforcement, safety, and other authorities in 2020–21.

Table 4.1 Sources of empirical data on event security

Stakeholder processes of smart urban and event security planning	
1. *Scenario building and simulation process with security agencies and actors* (a) Baseline survey: security actors (b) Three strategic scenario workshops for security officials (c) Two place-based security workshops for event organizers (d) One roundtable discussion concluding the workshop and scenario-building process (e) Six simulation manuscript workshops (f) Two simulation exercises (June 2021 and April 2022) (g) Two simulation feedback surveys	2. *Citizens and eventgoers as co-producers of a sustainably safe event city* (a) Two workshops for urban dwellers and local businesses and several meetings with housing company representatives in close proximity to the newly built arena for understanding the impacts of large-scale events on residents' experienced safety and everyday life (b) Arena visitor survey (n = 880, December 2021) for event guests attending the arena's first matches

Secure Urban Event Spaces Are Diverse Just Like the Cities Themselves

Security scenarios were created to guide the planning of event security measures in four different venues in the city of Tampere. The key defining factor that informed the venues' selection was their openness to different users and uses, and how familiar they were to the greater public or, as it turned out to be, to the safety and security agencies.

The classification into *open and closed spaces* defines how well the areas adjust themselves to everyday uses or different organized or spontaneous events, in addition to how porous their edges are (cf. Lynch, 1960; Ottone & Cocci Grifoni, 2017). The shifts in the guiding security concepts based on inclusion and exclusion, as well as control and trust, become conspicuous at the interface between public spaces and commercial or private spaces. For example, a festival area or shopping center is guarded by private security guards, whose task is to maintain order and secure the commercial interests of the space owner or event organizer. Open and public urban spaces, on the other hand, are fundamentally more flexible and provide circumstances for very different types of events and activities, including non-commercial ways of spending time. During events or festivals, these spaces may be partly turned into private confines, and streets may be closed off with security bollards.

The second division is based on the *familiarity of the place*: Newer places are those that had been recently constructed. Parts of new residential districts or areas recently introduced to the public as event infrastructures typically lack place-specific attachments and user experiences. Conversely, familiar venues are historically central and renowned urban places that almost every local dweller can pin on a map, in addition to being event areas. Compared with new spaces, the familiar ones may come with subjective meanings and memories that color one's experience, including their feeling of safety. The completely new spaces are more akin to blank canvases, void of related conceptions. Due to their unfamiliarity, their potential risks are largely unknown.

Familiar Venues: Central Square and Tampere Stadium

- Tampere Central Square is a typical downtown venue similar to other marketplaces and squares, which primarily serve as public spaces in their everyday use. The square can be utilized for different event purposes, and thus, the open space can be partly turned into closed or restricted areas. The square holds historical and symbolic value and hence possesses potential as a venue for action with societal or political motives. The increased visible drug use, particularly in an adjacent park, diminishes the square's attractiveness, with many residents finding it unsafe (City of Tampere, 2021). Local event actors would appreciate a more active presence of social workers and law enforcement in the area. Urban design solutions and street furniture that attract more locals and visitors could promote greater organic social control in the area (cf. "eyes on the street," Jacobs, 1961).

- Tampere Stadium in the downtown is a traditional venue for sporting events and concerts. It is a massive stadium structure built in the 1960s for special purposes and, especially during events, it becomes a genotypic confined urban space. Major events at the stadium attract thousands of people outside the venue. From the safety perspective, the venue's location in the urban core, on a narrow cape and in proximity to the lakefront, is regarded as its key spatial disadvantage. At a mass event in particular, the sheer concentration of people in a limited space significantly increases the likelihood of crowding and congestion, which poses a significant risk due to the dynamics of large crowds.

New Venues: Särkänniemi Event Beach and Nokia Arena

- Särkänniemi Event Beach is a park, an open space that was perceived as vulnerable to changing weather conditions by virtue of its location on a narrow strip of land between the Lakeshore Route (National HW12) and Lake Näsijärvi. The venue is largely unknown to the locals, and the routes leading to it are not particularly navigable. No prior user experience exists of the location as an event area nor as a venue for potential emergency operations. The following primary security questions were raised: How can highway traffic security equipment be managed to improve awareness of the Event Beach area's circumstances in the event/ahead of any potential emergency such as mass panic or extreme weather? How can the silos between traffic, police, rescue, and other agencies be overcome when determining the utilization of the traffic camera data flow?
- Tampere Deck and Nokia Arena are exceptional, even on an international scale, to such an extent that they required the development of completely new and customized area management models, rather than off-the-shelf methods for running this type of event area. This situation is novel for neighboring residents and authorities alike. The area illustrates the peak of the event era, restructuring both the cityscape and the downtown functions. All stakeholders involved in the scenario agreed that the growing city and its evolving event areas require the

actors responsible for event safety to prepare and train for new types of situations. Major events turn the Arena surroundings into closed security rings, and even the residents of the apartment buildings adjacent to the Arena may find their movements restricted.

What we discovered during this sense-making process was that although recurrent cooperation between the stakeholders existed, new ideas and tools were appreciated and required to solve existing challenges. For example, authorities would benefit from a common situation awareness and clearly communicated responsibilities, especially during events (cf. Karppi et al. in this volume).

The co-creation process brought to the fore the significance of a shared understanding of spatial settings and physical or institutional boundaries and interfaces. To identify the wider impacts, the events, their venues, and the surrounding urban spaces should be viewed (and planned) as a continuum. In a majority of observed cases, controlling crowds and managing people flows were deemed challenging in a finite space with competing uses. This calls for careful foresight and security planning. Cooperation between different stakeholders is required not only in managing temporary traffic arrangements but also for ensuring that no "gray areas" arise, where the mutual division of responsibilities between actors is at risk of remaining unclear.

As one participating event organizer put it, COVID-19 highlighted new security threats that require a new understanding of sustainably managed events and communication about them, thus creating a basis for a new safety culture. Sensitivity to the local context is necessary in security planning to ensure that the security measures and implemented technologies are in alignment with the scale, context, and nature of the event. In the next section, we continue to explore the challenges and possible solutions for planning sustainable and safe urban events from the viewpoint of those affected by the different socio-technical event arrangements, either as spectators or as locals living in the neighboring districts.

Trapped Inside the Event Security Ring?

In addition to the co-creation sessions with security and law-enforcement authorities and event-related stakeholders, participatory events with a focus on urban security were held with local residents and businesses. These gatherings discussed the city's transformation and related security concerns. As the newest and most central district, the Tampere Deck area had sparked extensive public local media discussion. The newly built area is a dense hub of various activities and forms of mobility.

Nokia Arena is an example of a global-scale experience venue. Its event arrangements affect the accessibility, availability, and usability of the surrounding urban space. In particular, the measures to securitize or, in practical terms, safeguard sporting mega-events limit the movement of people, including both event guests and local residents. The physical objects and artifacts for facilitating this securitization include safety fences, other barriers, and exclusion zones. Our interviews and workshops revealed that the Arena's neighboring residents are worried about disturbances during the events and their daily lives getting affected. The residents rightly felt that they should have equal rights to an ordinary life just like other urban dwellers—referring to unblocked streets and unharmed access to their properties. They required the guarantee of safety and undisturbed residential living for the neighborhood's various actors (church, businesses, residents) even during the Arena's events. Frequent negative side-effects that they highlighted include crowded streets and disturbances around the Arena. The resulting disorder was perceived as a threat to the urban district's overall safety and orderliness.

Underlying all these problems, the informants were keen to emphasize a perceived lack of timely communication between the neighborhood actors and the City Hall planning officials. Inadequate information or failure to grasp the intelligence it conveys is a breeding ground for conflicts and incidents that emerge at the boundaries of different systems (cf. Adams & Aizawa, 2010). Not being aware of the changes taking place, or things occurring without communication, engenders uncertainty. Lack of communication between the authorities, the venue operator, and the neighboring real-estate owners, housing companies, and other actors has fostered frustration among Tampere's residents. However, incidents have also been observed where the nuisance has been partly mitigated by denoting, closing, and defensing spaces with fences and gates (cf. Newman, 1996). Thus, protecting private property in the event venues' immediate vicinity by resorting to first-generation CPTED target hardening is still a visibly adopted practice in a city that strives to be a vanguard of smart safety and security.

The safety of residents is not the only responsibility of public officials, and the question of who communicates with whom regarding matters of safety and security is immensely complex. The role of security staff at the interface of event venue, its forefield, and the surrounding urban space has been found pivotal for protecting not only the venue and the event but also the event-related *experience* of the event guests and even the greater public (Gordon et al., 2016). Furthermore, visitors to the city play a multifaceted role in an event city's security complex. With regard to local economy, the role of visitors, tourists, and eventgoers is increasingly critical due to the growing experience economy and proliferation of event-related services. Moreover, event guests constitute another stakeholder group that can compromise or maintain events' safety and security. We were interested in their experiences related to event security and the utilization of technology within the innermost venue security ring—the entrails of the event arena itself.

An extensive visitor survey was conducted at the first ice hockey matches held at the Nokia Arena between December 3 and 28, 2021 (Vainio et al., 2023). Based on nearly 900 responses, it was concluded that the Arena broadly met the event guests' expectations, and it was believed to function well for ice hockey purposes. Accessing the Arena was deemed easy; however, while inside the arena, the corridors seemed to get easily crowded in a sold-out game. Professionally solid security checks and well-functioning maintenance of order were viewed as critical elements for ensuring event security and good event experience. Alcohol use by some event guests emerged as a notable source of concern and, to some extent, a more visible presence of security staff would have been welcome.

Findings from the survey highlighted the significance of striking a delicate balance between the visible and hidden features of safety-producing systems. For example, what excites and creates an enjoyable atmosphere for some can trigger insecurity in others; these differing needs must be recognized, preferably in advance. Different groups of people may also have conflicting needs, necessitating organizers to seek compromises. Visitors might enjoy the spectacle brought by the event at hand; however, for the next-door neighbors to the event arena, special traffic arrangements, crowding, and other discontents related to event spectacles encountered on a daily or weekly basis might be factors causing major stress or discomfort that affects their perceived quality of life. In sum, boundaries between spaces of different scales from personal properties to city blocks need to be respected and maintained for a positive event experience. Doing so would serve the interests of individual eventgoers, neighbors to the event arena, and the entire city that wishes to build and strengthen its reputation as a venue of vibrant and livable urbanity.

What is noteworthy here is that both visible and invisible as well as physical and technological solutions are required for securing these spaces and denoting their boundaries. Similar to event venues, contemporary cities are amalgamations of smart technologies and equally smart capacities to utilize them (Karppi & Vakkuri, 2020). Furthermore, cities also provide opportunities for achieving a broader understanding of what can be readily included in this smartness and what warrants exclusion (McFarlane & Söderström, 2017). Thus, the planning, construction, and utilization of smart event venues constitute an indispensable component of developing and designing smart cities that surround them. But that's not all. These venues operate at the interface between people and technologies, serving a mixture of temporary and permanent uses. Downtown spaces such as the Tampere Deck with the Nokia Arena portray urbanity in a supercharged form, encompassing social, spatial, temporal, cultural, financial, and, of course, political dimensions.

Conclusions: Planning for Situational Readiness and Smooth Experiences

Achieving a people-centered or a "beyond second-generation CPTED-secure city" requires both (1) multi-stakeholder and inclusive urban planning and (2) development of adequate readiness to operate effectively in varied situations such as events and other environments. Rather than prioritizing *either* generic capabilities for secure urban design *or* situational readiness to respond to security threats, the approach should encompass *both* aspects.

Since, in many cases, event arrangements affect the usability of the urban space that surround the event areas, planning of event environments must be integrated as an increasingly significant and meaningful component of planning usable and accessible urban spaces. Ultimately, an event city should be constructed as a part of a wider urban development strategy that has sustainability at its core. Forms of cooperation that are sensitive to the local context and contextually specific are needed at the interfaces between event areas and public spaces where responsibility of security is transferred between the city, security authorities, and event operators. Moreover, these responsibilities must be clearly defined, designed, and drilled to address key incident scenarios.

The possibilities for spontaneous use of urban spaces by locals and visitors—a characteristic feature of a vibrant urban space—should not be overly compromised for the sake of profitable mega-events. This matter can be approached both from a design perspective and from the viewpoint of promoting urban culture by asking, for example, how community-based safety in public spaces can be improved through planning, or how people can be supported in spontaneous deployment of urban spaces as event grounds.

Public authorities and regulation (e.g., GDPR) play a critical role in security designing and selection of security technologies; however, they cannot automatically guarantee these interventions' social acceptability. How can residents' experiences of a good and safe living environment be better ensured in the planning of a safe city? As discussed here, producing residential security primarily involves actions that enhance overall livability and foster a sense of community rather than integrating "hard" security measures. This sort of security thinking is based on the ideals of an open and deliberative society, and it requires identification of and communication with the providers and agents of safe city and safe events, including regular townspeople and eventgoers.

We sign off with three postulates for facilitating the pursuit of safe and secure urbanity in an event city.

First, Urban and Event Security Are Different Things Eventgoers and urban dwellers experience security-related matters differently: Their situational vantage points (event arena vs. public space) differ as frames for social action. Second, Organizing Secure Events and Building Safe Cities Is a Collective Endeavor The roles and perspectives of safety and security agencies, event organizers and venue operators, and eventgoers and urban dwellers need to be properly acknowledged in security governance. Third, Shared Situational Readiness Requires Seamless Communication Security stakeholders need appropriate tools and channels to jointly work toward achieving a shared understanding of eventual security incidences and situations. Acknowledgments Authors of this chapter have been partially supported through the Research Council of Finland, Grant #354867.

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5

Feeling Safe While Having Fun? Review of Experienced Safety and Fear of Crime at Events and Festivals

Remco Spithoven and Jelle Brands

Introduction

Events and festivals are big business. There is something special in the gathering of a crowd of people who enjoy music or other (cultural) experiences together. Throughout the world, a number of events and festivals hosted have "exploded" since the 1990s, and events are still recognized as a growing market worldwide (Bows et al., 2022a, b; Li & Wan, 2017; Pavluković et al., 2017). Stone (2009) has described as many as 17 different types of events on the basis of differences in demographics of attendees, style, and size (Bows et al., 2020, 2022a, b). Similarly, Brown and Hutton (2013) documented a long list of risk variables that might differ

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from one event to another, such as drug consumption (also see Lim et al., 2008). What can be deduced from such expositions is that events and festivals embody a wide range of (social) gatherings that differ according to "(…) size, duration, (musical) genre, patron demographics including age, class, sexuality, race and gender, and event-specific social and cultural norms, particularly around drug and alcohol consumption, and sexual activity" (Fileborn et al., 2020, p. 197).

Clearly then one event or festival is distinct from another. However, the overall goal of events and festivals is generally the same: offering visitors a positive experience and generating profit for the event or festival organizers. Much research has focused on the (positive) economic impact of events (Kim & Uysal, 2003; Pavluković et al., 2017). There is yet a broader social, cultural, environmental, economic, political, and quality of life impact of events and festivals that is not always positive (Pavluković et al., 2017; Platt & Finkel, 2020). Negative impacts of events and festivals can include "(…) overcrowding, traffic, litter, noise and disruption and intrusion into the lives of local residents" (Pavluković et al., 2017, p. 24, also see Barker et al., 2003). Kim and Uysal (2003) also indicated that crime rates and the pressure on local (policing) services increase during events.

Hoover et al. (2022, p. 202) highlighted the heightened risk of various forms of criminal victimization such as "(…) pickpockets, sexual assault, and terrorist attacks (…)" as another negative impact, which is especially relevant to the contents of the current chapter. Notwithstanding these negative effects, surprisingly little research attention has been paid to exploring how such risks of crime victimization are (emotionally) experienced, how safe people generally feel at events and festivals (Barker et al., 2003; Bows et al., 2020), and whether the safety risks lead people to avoid or be constantly alert during events and festivals. This would negatively affect visitors' well-being and might pose a threat to the popularity and future of events in the long term (Barker et al., 2003; Pivac et al., 2019). This research lacuna stands in contrast with the increased research as well as political and media attention directed toward incidents of sexual harassment during music festivals (Bows et al., 2022a, b). Indeed, research has indicated that one-third of female visitors have experienced sexual harassment and 8% have experienced sexual assault in a music event setting in the UK. In the USA, 90% of female attendees of music events reported experiencing sexual harassment (Bows et al., 2022a, b; OMMB, 2017; YouGov, 2018). More generally, 43% of women and 22% of male visitors experience unwanted behavior at music festivals in the UK; however, only 2% report these incidents to the authorities (Bows et al., 2022a, b). Hence, while victimization due to unwanted behavior, sexual harassment, and violence at events and festivals presents a significant social problem that has already garnered substantial attention (ibid.), to date, it remains unclear the extent to which visitors to events and festivals actually experience fear or feel worried about these (and other types of) risks. Furthermore, the absence of this information is somewhat surprising when one considers the research, political, and media attention received by the excesses stemming from (somewhat) comparable liminal settings such as the night-time economy, particularly how such excesses are related to experienced safety and fear of crime. In the current chapter, we therefore aim to answer the following research question: What is known about event and festival attendees' fear of crime and the factors explaining it?

Below we will first explore the special nature of events and festivals that could be possibly related to the (perceived) threat of victimization. Subsequently, we will conceptualize fear of crime, followed by conducting a review of the literature that revolves around event and festival visitors' fear of crime. The results of our review will then be compared with findings from the broader literature on fear of crime to contribute to the discussion about fear of crime at events and festivals.

What Is Special and (Potentially) Unsafe About Events and Festivals?

Events and festivals enable attendees to escape from the normative boundaries of daily life (Baillie et al., 2022; Bows et al., 2020; Khazaie et al., 2021). Events and festivals offer a "time out" of daily life where people can transgress norms and rules, experience liminality, and consume more drugs and alcohol than they normally do in their daily lives (Bows et al., 2020). In this fashion, events and festivals share a function with the night-time economy (see Van Liempt et al., 2015). Similar to those frequenting nightlife, event and festival visitors generally seek community and fun (Hoover et al., 2022) and desire to find a liminal experience away from societal norms and rules of daily life (Bows et al., 2022a, b; Crampton et al., 2020; Fileborn et al., 2020; Hoover et al., 2022; Platt & Finkel, 2020).

Liminal spaces are "(…) between the fluid and solid social structure, shifting between safety and risk of the social and the natural" (Skinner et al., 2003, p. 82, as quoted by Bows et al., 2022a, b, p. 3). Much of the visitors' attraction to events and festivals can be attributed to this liminal atmosphere that revolves around a shared positive experience and a common purpose with other people in a specific time and space (Fileborn et al., 2019; Hoover et al., 2022; Li & Wan, 2017). Hutton et al. (2018) referred to Getz's (2005) concept of *communitas* to describe an event audience's experience of kinship and sense of belonging. Individual visitors of events bond together by virtue of temporary shared social identities that are rooted in "trust, respect, cooperation, social support, and resilience" (Khazaie et al., 2021, p. 2). The general mood at an event or festival then is that of "escapism and excitement," according to Palamar and Sönmez (2022, p. 10). This positive atmosphere of events and festivals is clearly supported by the "vacation modus" of visitors (Palamar & Sönmez, 2022) and the opportunity to be in the presence of friends (Crampton et al., 2020). Yet, despite the "(…) sense of general friendliness and trust (…)" among visitors (Wilks, 2011, p. 281), it has been argued that few to no new relationships develop at events and festivals. Moreover, attendees of events and festivals tend to form a rather homogeneous group populated by "(…) the upper levels of socio-economic categories and educational qualification levels" (Wilks, 2011, p. 293).

Being emotionally charged, liminal spaces and experiences (Brown & Hutton, 2013), events and festivals also give way to various risks to personal safety. Again, clear parallels can be drawn with the night-time economy, where such risks and downsides are widely recognized: "It is therefore not surprising that certain forms of violent crime, criminal damage and antisocial behavior are concentrated in and around nightlife areas" (Van Liempt et al., 2015, p. 407). Events and festivals usually result in large numbers of people gathering, and this increases the potential for criminal activities due to the presence of a large number of unidentified individuals in an area, with potential targets exhibiting signs of wealth by carrying valuable belongings (Badiora & Bako, 2020; Barker et al., 2003). Risks at music festivals include "(…) pickpockets, sexual assault, and terrorist attacks" (Hoover et al., 2022, p. 202). Crowd violence is a big risk at nearly all events and festivals, and there are also risks of unwanted security behavior, physical assault, and solicitation of illegal substances at various types of events (Crampton et al., 2020). As mentioned earlier, however, little research has investigated how (such different) risks related to crime and unsafety are experienced by visitors of events and festivals. Below, we will pay attention to how fear of crime is broadly defined in research. We will then review previous research that has examined experienced safety and fear of crime in the context of events and festivals, in terms of both how safe people feel at festivals and events and what might be causing experienced lack of safety or fear of crime.

What Is (Situational) Fear of Crime?

A clear and growing research interest in fear of crime can be traced back to the 1960s (Ditton & Farral, 2000; Hale, 1996; Spithoven, 2017). In fact, a recent systematic review reported a marked increase in the number of studies published and cited about fear of crime over the past 25 years (Hart et al., 2022). Much of what has been written on the subject revolves around defining and measuring fear of crime. By now, scholars tend to agree that (emotional) fear of crime should be understood as a complex, layered phenomenon, for which "no universally accepted definition (…) has emerged" (Henson & Reyns, 2015, p. 92). Following the National Crime Victimization Survey, early research into fear of crime tended to rely on (a variation of) the following question to measure fear of crime: "How safe do you feel/would you feel being out alone in your neighborhood after dark?" However, scholars have, by now, agreed that perceived safety measures encompass much more than solely emotions (or even perceptions) related to the threat of crime victimization. This does not imply that people cannot mean (roughly) the same thing by it in their daily use of the term. The term perceived or experienced safety then logically encompasses fear of crime but is not limited to it. For the purposes of this chapter, we will define experienced safety as "[a] complex accumulation of interacting feelings, perceptions, emotions, values and judgments at personal and collective levels, related to crime or symbols that a person associates with crime" (Spithoven, 2017, p. 78, based on De Groof, 2006; Ferraro, 1995; Ferraro & LaGrange, 1987; Pleysier, 2010; Jackson, 2006). According to some researchers (see, for instance, Rader, 2004; Rader et al., 2007), constrained (defensive and avoidant) *behavior* in response to the threat of crime victimization should also be included in this definition.

It is critical to underscore that scholars investigating fear of crime have highlighted that much of the meaning of the traditional findings remains quite unclear owing to (mostly) implicit (see above) and otherwise inconsistent use of definitions, a restricted employment of research methods, and under-theorization (Hale, 1996). This has led some scholars to conclude that fear of crime is (too often) studied as a rather "decontextualised snapshot" (Farrall et al., 1997, p. 660) that is based on "a simplistic, numerical answer to a closed question [of which] we cannot hope to represent the breadth of experience and feelings about crime experienced by most people" (ibid., 661). When fear of crime is treated as the multidimensional phenomenon it actually is (Farrall et al., 2009; Girling et al., 2000; Hirtenlehner & Farrall, 2013; Lee & Farrall, 2009), more justice can be meted out to the elements that contribute to specific negative experiences (Hale, 1996). One specific response to the challenges summarized above is presented by a distinct branch of literature on fear of crime that revolves around a more concrete experience of worry about or fear of crime in particular situations, constrained by specific spatial and time boundaries.

Addressing what is often referred to as situational fear of crime, this branch of literature is specifically interested in fear of crime as a

> time and space-specific response to external stimuli of crime, crime signals or crime symbols, leading to a sense of immediate threat to one's security, which discharges into feelings of alertness, threat or fear, as one identifies

> the private self as the potential victim of a—whether or not actually present—'dangerous other', based on an assessment of vulnerability and a perceived lack of control. (Spithoven, 2017, p. 77, based on Farrall et al., 2009; Ferraro, 1995; Ferraro & LaGrange, 1987; Pleysier, 2010; Sedikes & Brewer, 2001; Van der Wurff, 1992)

This specific and relatively limited body of literature on fear of crime has offered insights into how personal and situational aspects lead to experiences of safety and unsafety in several specific situations.

Events and festivals are unique and clearly defined situations (Bows et al., 2022a, b; Dilkes-Frayne, 2016). As we have explored above, events and festivals are not free from risks, unwanted behaviors, and crime, and this makes them highly suitable for studying time- and space-specific experiences such as *situational* fear of crime.

What Is Known About Fear of Crime at Events and Festivals?

To explore what is currently known about fear of crime and experienced safety at events and festivals, as well as the factors explaining this phenomenon, we employed various approaches to find and review relevant contributions from academic studies. We first conducted a search in the electronic journal database Web of Science, using the search string "((((fear OR worry) AND crime) OR ((experience* OR perceive* OR subject*) AND safety)) AND (festival*))."[1] This yielded a return of 53 potentially relevant manuscripts that were initially assessed on the basis of their title and summary. The same search string was used in Google Scholar, subsequent to which the first 100 returns were assessed on the basis of their title and summary. Those contributions that held relevance to our research question were thoroughly read and integrated into our review that is presented below. The reference lists of these contributions were also checked for relevant studies. Finally, this selection of

[1] We also ran a search string that included the term "event*," but this rendered an infeasible amount of studies. It is for this reason that we decided to exclude the term from our search string.

contributions was compared with the sources we had personally collected on the topic over time; no further additions were made in this step. While we do not claim that we have been able to present a complete bibliography on the topic at hand, we do take the latter to be an indication that our search strategy at least rendered a sample of critical contributions on the topic. After completing these steps, we could include 35 publications that were (partially, some marginally) relevant to our primary question: What is known about event and festival visitors' fear of crime and the factors explaining it?

To What Extent Do Visitors Experience Safety at Events and Festivals?

Unfortunately, we did not encounter any specific quantitative measurements of *fear of crime* or situational fear of crime in the specific body of literature we curated. However, studies by Bows and colleagues (2022a, b), Bows et al. (2020), and Fileborn et al. (2019) (quantitatively) studied the experience of safety of visitors of events or festivals. Bows et al. (2020) discovered that of their 450 respondents in the UK, a majority reported usually feeling safe (51%) or always safe (35%), with a clear minority reporting feeling rarely (3%) or never (0.4%) safe at music festivals. Similar results have been reported by Fileborn et al. (2019) for a sample of visitors of Australian music festivals, who reported feeling usually (61%) or always (29%) safe. In a later study by Bows and colleagues (2022a, b), 9 out of 10 respondents reported feeling usually or always safe at the music festivals they had visited in the UK in the previous year. Overall, these studies then indicate that a majority of the research participants tend to feel safe at festivals. Simultaneously, Bows et al. (2020, p. 96) also mentioned that "various personal, social, and environmental features increased or reduced their feelings of safety along with some spaces within festivals that they felt particularly unsafe" such as campsites, walkways, toilets, and woodlands.

Despite these interesting statistics, the general fear of crime research suggests that we should preferably not solely rely on "perceived safety items" as a measure of (situational) fear of crime, because these single-item measurements lack attention to specific crime risks, do not specifically address emotion, and do not refer to a specific place and time (Farrall & Gadd, 2004; Hale, 1996; Spithoven, 2017). Hence, it would appear that our current understanding of the extent to which visitors experience safety at events and festivals, as well as quantitative analyses of visitors' fear of (particular types of) crime at events, can be improved and detailed further. This also applies to quantitative research on factors related to fear of crime at events and festivals.

Importantly, we do learn from the reviewed literature that quite a few visitors of events and festivals have had negative experiences during visits and have even been victims of crimes (Bows et al., 2022a, b). However, many of these publications are, at their core, about crime victimization and not about *fear* of crime *per se*. Then again, (a perceptual threat of) crime victimization is obviously related to (situational) fear of crime, and in some of the publications, this "idea" or relationship features as part of the broader results but generally does not take center stage. Based on such (primarily) qualitative contributions, we were able to identify the following three narratives that relate to the fear of crime at events and festivals: (1) worry or fear concerning sexual harassment and violence experienced by women, (2) specific environmental factors that might be related to the experience of safety at events and festivals, (3) another unexpected "worry" that is related to (getting caught with illegal substances by) the police and security personnel, especially among young males.

Narratives From the Reviewed Literature About Fear of Crime at Events and Festivals

Sexual Harassment, Violence, and Gender Women report being victims of sexual harassment and violence at music festivals, whereas men more often report being victims of physical violence (Crampton et al., 2020). Previous literature has argued that sexual harassment and violence are connected to a culture in which unwanted sexual attention is perceived as "normal" or "accepted" in certain social settings (Williams & Murray, 2022). One reason for this may be that music events have generally become more sexualized over the years (Fileborn et al., 2019). And the use of drugs, which has become normalized in some subcultures subscribed to by the publics that visit events and festivals (Lim et al., 2008), and alcohol consumption at festivals lead to the overlooking and quiet tolerance of antisocial behaviors in general (Fileborn et al., 2019, 2020). Authors have also mentioned that alcohol consumption also results in a masculine atmosphere, "(…) where unwanted sexual attention becomes accepted as a normal part of being in public places" (Bows et al., 2020, p. 10, also see Fileborn et al., 2019). According to previous research, we have to understand the threats of sexual harassment and violence to female visitors of events and festivals against the background of societal, gendered power relations (Baillie et al., 2022; Fileborn et al., 2019, 2020). This stance counters the general assumption of communitas, which refers to the sense of kinship, "trust [and] respect" (Khazaie et al., 2021, p. 2) experienced by audiences of an event, where every visitor is viewed as equal to the other (Platt & Finkel, 2020).

Regarding women's experiences of sexual harassment and violence, some studies have discussed various strategies and behaviors that could be understood as "constrained" or "defensive" behavior, as discussed by Rader (2004). Reviewed studies showed a tendency to favor the term "safety work" (Vera-Gray & Kelly, 2020). For instance, Bows and colleagues (2020, p. 4, quoting Hollander, 2001, p. 105) explain that "(w)omen report constantly monitoring their environment for signs of danger, hesitating to venture outside alone or even in the company of other women, asking men for protection, modifying their clothes… and restricting their activities…. These strategies are simply part of daily life as a woman." While being *"part of daily life as a woman,"* such behaviors and strategies seem to stem from risk perceptions and worries related to (sexual) crime victimization (also see Vanderveen, 2006).

Similar to the quote above, the reviewed literature reports various strategies that female visitors adopt when attending events and festivals. Many young women visit events and festivals only in the company of friends, especially male friends, according to Aborisade (2021). We find other examples in the recent study by Bows and colleagues (2022a, b, p. 11), in which they stated, "[w]omen told us they adopted a number of strategies to protect themselves against expected sexual harassment and aggression. This included avoiding certain spaces, ensuring they/their friends were never on their own, or reducing their alcohol consumption." Furthermore, Wadds et al. (2022, p. 12) mentioned that "almost all female participants discussed engaging in extensive 'safekeeping' or precautionary routines," with a female respondent narrating her experience as follows: "I spend the whole time at festivals 90% like dancing and talking to friends and 10% just like looking around me for keeping myself safe (…)."

Environmental Factors Certain environmental factors were identified in the reviewed literature that were considered to contribute to experienced unsafety at events and festivals. Some of these factors were specific to the behaviors and strategies discussed above. Environmental factors related to criminal opportunities for perpetrators have been reported to increase the fear of crime at events and festivals. These factors include "(…) crowd size and density, scale of festival grounds, limited means of formal security and surveillance, lighting versus darkness, anonymity and isolation" (Aborisade, 2021, p. 73; also see Fileborn et al., 2019). People tend to feel safe at events and festivals in the presence of friends, while feelings of insecurity can arise from the use of alcohol and drugs by others, in addition to the presence of groups of men. Visitors of events and festivals primarily attributed their sense of unsafety to reasons such as bad lightning and bad behavior of security personnel (Aborisade, 2021; Bows et al., 2022a, b; Fileborn et al., 2019). As mentioned earlier, these explanations typically emerged from qualitative studies, and there is a lack of (quantitative) contributions that assess the relative significance of such (and other) explanations for experienced unsafety and fear of crime.

Negative Side-Effects of Surveillance and Policing Strategies The reviewed literature also demonstrates that certain policing and security strategies can compromise an atmosphere of fun and safety due to "harsh" and/or over-policing (Hoover et al., 2022). Strict and harsh access control serves as an example of factors that may amplify risk perceptions (Crampton et al., 2020) and lack of experienced safety, especially among male visitors (Hoover et al., 2022). When policing is almost solely about preventing drug use,[2] it can result in a strong tension between the (private) police and the public (Bows et al., 2022a, b; Fileborn et al., 2018, 2020). When a drug-sniffing dog is stationed at the entrances, for example, young inexperienced drug users are even more likely to overdose as a result of taking all their drugs at once—an act that is known as "panic consumption" (Grigg et al., 2018)—out of fear of getting arrested (Palamar & Sönmez, 2022).

Women also indicated refraining from reporting victimization of sexual violence at events and festivals due to the harsh policing at entrances (Fileborn et al., 2019). Formal surveillance and policing practices at festivals can also be discomforting for visitors as they significantly change the atmosphere of the event. This can trigger surveillance anxiety—an "(…) acute persistent worry and stress experienced by individuals and groups as a result of known or expected surveillance" (Crampton et al., 2020, p. 361)—as visitors might worry about how they may be (mis) judged, leading to "exploitation, punishment, or social disparagement" (ibid.).

Hoover and colleagues (2022) highlighted that security personnel might, in fact, pose a risk to female visitors. Similar to what is observed with urban nightlife security staff, security personnel and their practices at events and festivals may also contribute to a culture of masculinity and sexism (Bows et al., 2020; Hobbs et al., 2003; Winlow & Hall, 2006). Quite strikingly, we found very little mention of positive experiences related to the presence of surveillance and policing and/or how they might affect safety (in particular situations) in a positive manner. It is unclear to us if this is the result of research being primarily focused on negative side-effects (with positive emotions being sidelined) or that surveillance and policing are indeed (mainly) perceived in a bad light at events and festivals.

[2] According to authors such as Palamar and Sönmez (2022), this is done for justifiable reasons, given the adverse drug-related effects at events.

Conclusion, Discussion, and Practical Implications

On the basis of our review, we conclude that fear of crime and experienced safety at events and festivals can be considered a somewhat underexplored but highly interesting and relevant research topic (particularly as highlighted by the qualitative studies in the field). A majority of studies included in our review primarily focused on victimization and objective unsafety at events and festivals. Sometimes, subjective safety and fear of crime were touched upon in these contributions; however, generally speaking, they did not feature centrally in the results. Importantly, we noted that some *quantitative* research on the topic is *emerging* (e.g., Bows et al., 2020, 2022a, b; Fileborn et al., 2019) and trying to unveil the extent to which visitors experience unsafety at events and festivals. The scope of such research is still somewhat limited in terms of operational definitions of fear of crime, and we have not encountered specific measurements of *situational* fear of crime at events and festivals. We would, then, argue that lessons learned from the *quantitative* studies on fear of crime could further inform these first attempts and help develop focused and detailed measures of subjective safety and the perceived threat of and worries about crime victimization at events and festivals.

Furthermore, we encountered some interesting *qualitative* research discussing behavioral strategies (routinely) practiced by women at events and festivals, which can be understood *in relation* to experienced lack of safety and/or worries about or fear of crime. These strategies or "safety work" (see Vera-Gray & Kelly, 2020), as it was sometimes referred to in the reviewed literature, predominantly centered on women's safety, specifically addressing a rather critical type of victimization: sexual harassment and sexual violence. We observe a connection with the broader literature on fear of crime, which adds a behavioral dimension to fear of crime, distinguishing between avoidance and defensive behaviors (see Gabriel & Greve, 2003; Rader, 2004; Rader et al., 2007). A prominent related question is whether, and to what extent, potential visitors of events and festivals might also actually stay at home due to their anticipated fear of crime. Although it is much easier to avoid an event or festival than certain public spaces such as city centers, squares, and parks, we see possibilities to learn from what is known about avoidance behavior in the general fear of crime literature to study avoidance behavior at events and festivals. When investigating avoidance behavior, future studies should also carefully distinguish between perceived crime-related factors and other reasons why people choose not to frequent events and festivals to better understand their relative significance.

In terms of what "causes" the fears reported at events and festivals, the studies we reviewed repeatedly emphasize that a significant percentage of female visitors in the UK and USA have reported to have fallen victim to unwanted behavior, sexual harassment, and even sexual violence at events and festivals. Some studies suggest that due to the liminal character of events and festivals, general gendered power relations seem to become amplified, turning an atmosphere of fun into a hostile environment for women. These studies also suggest that it is men who experience freedom at events and festivals, while women are vulnerable to sexual violence (Aborisade, 2021; Baillie et al., 2022; Bows et al., 2020, 2022a, b; Crampton et al., 2020; Fileborn et al., 2019, 2020; Hoover et al., 2022; Platt & Finkel, 2020; Wadds et al., 2022). The general fear of crime literature, in turn, has placed much emphasis on the concept of vulnerability to explain the experienced lack of safety and fear of crime. Being a multidimensional concept, vulnerability is defined as "(…) an individual's sense of exposure to risk, the expectance of serious consequences, a loss of control over a situation or an inadequate ability to manage the direct and indirect consequences of a threatening situation" (Spithoven, 2017, p. 86, based on Cops, 2012; Farrall et al., 2009; Kilias, 1990; Pleysier, 2010). This experience is theorized to be rooted in multiple background variables such as gender, age, and socio-economic factors (Hale, 1996; Spithoven, 2017).

Gender has received much research attention in this context and is believed to be the most vital predictor of fear of crime, as women report higher levels of fear of crime than men. While the actual reasons for the recurring observation that women are more fearful than men may vary, a branch within fear of crime studies has concentrated on "the shadow of sexual assault." The primary postulation of this literature is that women's higher levels of fear of crime are the result of women's fear that a variety of types of victimization may develop into sexual violence (Ferraro, 1996; Hirtenlehner & Farrall, 2014; Jackson, 2009, 2011; Vanderveen, 2006; Warr, 1985). According to some authors, this general danger must be seen as a product of constant reproduction of gendered power relations in which socialization of boys and girls is of crucial importance (Warr, 1984, 1985, 1987; Ferraro, 1996, also see Reiner, 2007).

We also came across signs of the negative impact of policing and security strategies, which was somewhat surprising. Visible security measures and the presence of security and police can result in an amplification of perceived risks, leading visitors to feel more unsafe (see, for instance, Crampton et al., 2020), which has also in part been recognized in the general fear of crime research (Cook & Whowell, 2011; Van de Veer et al., 2012; Doyle et al., 2016; Hinkle & Weisburd, 2008). At the same time, one would expect that the role of surveillance and policing strategies would also align with the idea of reassurance policing, which centers on addressing the concerns of local residents (Hale, 1996). Clearly, it is necessary to make a distinction between what the police do to deter and apprehend criminal offenders and what they should do to mitigate fear of crime among the general public (Cordner, 1986; Goldstein, 1977). Furthermore, in sharp contrast to the findings on experiences of unsafety as a negative side-effect of policing and security strategies at events (Bows et al., 2022a, b; Crampton et al., 2020; Fileborn et al., 2020; Hoover et al., 2022; Palamar & Sönmez, 2022), the general fear of crime literature focuses on the phenomenon of symbolic reassurance in which police presence is generally believed to actually *curtail* feelings of unsafety (Grabrosky, 1995; Hale, 1996; Henig & Maxfield, 1978; Van Noije & Wittebrood, 2010). A general question remains: What mechanisms underlie such differences?

Specific environmental factors that are perceived as (potentially) triggering fear of crime at events and festivals share some similarities with the factors found in general research on fear of crime. In particular, the presence of crowds, groups of drunk males, a lack of surveillance, and poor lightning constitute fear triggers that have been reported in literature on general and situational fear of crime (Farrall et al., 2009; Hale, 1996). This latter, specific, literature treats the experience of "(…) a sense of immediate threat to one's security (…)" (Farrall et al., 2009, p. 18) as an individual's reaction to the perception of specific stimuli in their immediate environment in a particular situation. People continuously and unconsciously scan their immediate surroundings for cues they know to be related to heightened risk of crime. Networks of these crime cues are stored in so-called mental maps that contain information on where, why, and how crime occurs in locations and situations. This knowledge is the result of both direct and indirect victimization, talks on crime, media reports, and the like. When people perceive stimuli they consider to be related to the risk of crime, their awareness gets triggered. To be more specific, people scan their surroundings for (cues of) criminal activities, social and physical incivilities, potential lurk lines, escape ways, the state of the environment, and potentially dangerous others. Furthermore, a sense of anonymity and a limitation of sight trigger a sense of alertness (Brands & Spithoven, 2023; Hale, 1996; Spithoven, 2017). Again, we would argue that empirical findings on fear of crime at events and festivals might benefit from the complexity brought to the fore by the general fear of crime research. Explanations presented in these studies might inspire and inform (quantitative) research into the (relative importance of) explanations of experienced unsafety and fear of crime at events and festivals.

Some methodological considerations relate to our central findings. We consider it advisable to employ more detailed measures of fear of crime (see above) to explore this phenomenon. Studies might also benefit from real-time app-based measurements that map *fear events*, rooting relevant user experiences in space and time (Solymosi et al., 2021). Some small-scale experiments have been reported involving app-based reports concerning the overall experience of event visits (Dewilde et al., 2021). These experiments could be expanded by asking specific questions about general fear of crime after the event or festival or by enquiring about situational fear of crime during the event or festival. Designing such a method or tool presents a challenge in terms of determining the appropriate way to approach and ask event and festival visitors about their crime fears and victimization worries in a manner that is ethically considerate and does not exacerbate potential victimization concerns. This seems especially significant in the context of events and festivals, given the prominence of sexual harassment and violence as a theme in extant literature. In addition to such a quantitative approach, we suggest that the field might also benefit from (qualitative) participant observation, particularly in relation to visitors' constrained behavior and safety work. Although (qualitative) participant observation has been utilized at events and festivals quite regularly to describe visitors' general behavior in the form of social interactions and relations (Mackellar, 2013), we did not encounter any studies in our review that have focused on behavior related to the threat of crime victimization. Given the observation that visitors of events tend to form a rather homogeneous group populated by "(…) the upper levels of socio-economic categories and educational qualification levels" (Wilks, 2011, p. 293), we also suggest exploring this specific group of visitors' fear of crime and factors contributing to their experienced lack of safety. Simultaneously, researchers should also explore if other groups in society might experience the threat of crime victimization to such an extent that they might even avoid visiting events and festivals due to their fear of crime levels.

Since the impact of sexual harassment and violence (on experienced safety and fear of crime) is the most prominent theme we encountered in the reviewed studies, more discussion on ways of mitigating these risks is necessary. Although we, as scholars working on fear of crime, do not specialize in this topic, some suggestions came to mind building on the reviewed studies. Essentially, it could be argued that more research needs to be conducted to prevent sexual violence at events and festivals by adopting a collective community prevention approach (Bailey et al., 2022; Bows et al., 2022a, b; Fileborn et al., 2019; Hill et al., 2020). In this approach, all visitors would be held responsible for the safety of women at the festival as a community. They would be trained to intervene in the early stages of sexual violence, such as unwanted behavior or the use of degrading language, without making accusations or being aggressive (Bailey et al., 2022). Local authorities, event and festival staff (see Bailey et al., 2022; Earl et al., 2005; Williams & Murray, 2022), and especially visitors should be trained to "(…) recognize and respond to situations in which sexual assault or harassment has the potential to occur, is occurring, or has occurred" (Bailey et al., 2022, p. 714; also see Banyard, 2008; Potter, 2012; Sampsel et al., 2016). For instance, by training people to recognize potentially unsafe situations for women and implicit signs of victimization as well as educating them on strategies for responding to such potential occasions of sexual assault or harassment, sexual violence might be be prevented.

It is, therefore, also critical to explicate sexual harassment and violence as broad concepts that revolve around a continuum of sexual violence, ranging from pressure and threat to coercion (Fileborn et al., 2019; Kelly, 1987). However, a structured approach to prevent sexual violence at events and festivals has not been implemented yet (Baillie et al., 2022; Fileborn et al., 2019; Fileborn & Wadds, 2018). While we acknowledge that the risk for sexual harassment and violence will differ from one event to another due to variations in social contexts, event attendees, and event style (Williams & Murray, 2022), it would be generally helpful to facilitate discussion and cooperation between event and festival organizers and the local authorities. This can lead to the adoption of a stronger stance against the risk of sexual harassment and violence (see Aborisade, 2021; Hill et al., 2020; Sampsel et al., 2016). For example, organizers can ensure that women who report having fallen victim to sexual violence receive proper care, encouraging them to report the incident to the authorities, and potentially, depending on the nature of the incident, remove perpetrators from the premises and hand them over to the police.

In conclusion, there is clearly no one-size-fits-all solution for mitigating fear of crime at events and festivals (Crampton et al., 2020; Hoover et al., 2022) or in general (Grabosky, 1995; Hale, 1996). When addressing experienced lack of safety and/or fear of crime, underlying causes have to be charted and realistic goals need to be set that are within the reach of professionals (Farrall et al., 2009; Hale, 1996). Literature on mitigating fear of crime is clear in one regard: A practical approach has to be derived from tailor-made analyses (Hale, 1996; Henig & Maxfield, 1978; Van Noije & Wittebrood, 2010). Hence, for specific (types of) events and festivals, it is necessary to determine what causes (situational) fear of crime among visitors. This aligns with a more general call for event and festival organizers to understand the motivations, behavior, and predispositions of their visitors to address them effectively during events (Barker et al., 2003; Brown & Hutton, 2013; Hutton et al., 2018; Mackellar, 2013; Pivac, et al. 2019).

While our review identified a surprisingly limited number of academic publications that have specifically and at their core reported on fear of crime and experienced safety at events and festivals, leading to limited insights into the factors that explain attendees' fear of crime, we hope that our reflection on the general fear of crime research serves as a source of inspiration to further expand and enrich the existing body of literature on this important topic. Clearly, not every visitor will feel safe at events and festivals, and some people might well avoid them due to their fear of crime. Further research is required into the actual fear of crime experienced by attendees of events and festivals as well as on strategies for mitigating this fear to ensure that everyone can feel safe while having fun.

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6

From Risk Management to Urban Resilience: Urban Development in the Context of the Twenty-First-Century Disaster Risk Reduction Framework

Konstantina Karydi

Introduction

The past 15 years have witnessed a steep growth in the adoption of the concept of urban resilience as a key urban development approach, particularly by subnational authorities whether city or regional governments and states. This chapter frames in a comparative global context the evolution of urban resilience, both as a means to change management in local administration and as a central policy goal to address the unprecedented twenty-first-century shocks and stresses. Furthermore, the chapter discusses urban resilience in the context of the city of Tampere and the SURE program under the Urban Innovative Actions initiative—the case featured in this book.

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Resilience building has gained significant momentum over the previous decade as a policy agenda of local governments of all sizes. The starting point of this development was the recognition that while cities are growing exponentially, they are facing threats that are more acute and regular owing to changing climate conditions, rapid urban growth, and globalization trends. In this light, the development strategy of risk reduction is gaining traction as a game-changing paradigm. Its aim is to ensure that bearing the cost of managing augmenting crises does not become unsustainable in terms of financial and material resources and, more importantly, to reduce the threat of human casualties. Nevertheless, as it is more often than not the case with policies, there is no single definition for urban resilience. The term itself certainly does not belong to the field of urban development alone; rather, resilience is an old term commonly employed to describe human behavior in psychology and ecosystem dynamics in environmental and social studies. The concept of resilience broke ground during the ecological movement as early as the 1960s as an approach to challenge the prevailing notion of stable equilibrium. In response to major mega-trends such as climate change, urbanization, and transformation, multiple global entities have come together to pool knowledge, resources, and expertise toward both generating a deeper understanding of the urban resilience agenda and setting the foundation for more effective implementation of this agenda and improved resource management. In doing so, their aim is to address the significant risks of the twenty-first century and effectively protect human life and prosperity.

Urban Resilience and Mega-trends in the Global Urban Policy Agendas

Resilience practices provide a framework for new models of governance and organization to address wicked problems in situations characterized by uncertainty and complexity. In the previous decade, the focus of relevant policy has moved from disaster management and risk reduction to holistic resilience, incorporating development and social agendas.[1]

A dynamic relationship exists between the tripartite factors of urbanization, interdependence (and geopolitical shifts), and climate change that determines cities' positioning in terms of threats and opportunities. This connection is reflected in the numerous influential international agendas that have been adopted progressively over the last 10 years. While the conversation on the development of urban agendas is far from new, it intensified after 2010 in light of the preparations for the adoption of the Sustainable Development Goals (SDGs), the elaboration of the global New Urban Agenda, the Sendai Framework for Disaster Risk Reduction, and, at the European level, the elaboration and ultimately the final adoption in May 2016 of the European Urban Agenda, followed by the most recent evolution, the European Urban Initiative (announced in March 2023).

Resilience, particularly urban resilience, has been directly adopted as a key goal in the post-2015 agenda, appearing as a cross-cutting theme across all of its major global agreements and beyond (Garschagen, 2016). Interestingly, the connection between resilience building and cities is not only evident in the explicit mentions in international framework agreements but is also implicitly alluded to in the references to the pivotal role played by cities in implementing these frameworks and in the recurring acknowledgment that policy efficiency hinges on institutionalized collaboration across sectors and among various actors. Furthermore, this relationship is underscored in the calls for change toward a paradigm shift that is necessary in the face of the twenty-first-century global challenges. Resilience building has been highlighted both as an end goal in itself, as seen in SDG #11 focusing on the resilience of cities and SDG #1.5 concerning the resilience of people, and as a mechanism or a methodology for advancing institutional change, growth, and equity in a manner that is exemplified by the UNDRR-led Making Cities Resilient Campaign 2030 or the UN-Habitat Cities Investment Facility.

[1] The UNDRR Sendai Framework for Disaster Risk Reduction 2015–2030 exemplifies this policy approach.

A further layer of complication is added in the recognition that multilateral institutions' resources are not sufficient for dealing with any damage; therefore, collaboration across sectors is critical (World Bank Group, 2016; Independent Evaluation Group, 2019). While this acknowledgment clearly recognizes the potential risk posed by unmanaged urban systems, solely adopting a disaster risk management approach for urban ecosystems runs the risk of over-simplifying the understanding of human-ecological interactions by limiting the comprehension of the system dynamics within those same urban ecosystems (Ferrao Paulo et al., 2013).

The COVID-19 global pandemic brought the resilience agenda at the forefront of national policy design, as evidenced by initiatives such as the European Resilience and Recovery Plans—based on the largest long-term budget in the history of the European Union. In fact, it would be difficult to comprehend the dynamics informing the development of the resilience agenda without taking into account the relationship between the three defining pillars of the urban resilience movement—urban growth, climate change, and interdependence. These three global trends currently guide the actions of global international and intergovernmental organizations and government, or non-governmental entities involved in shaping the policies and practices pertaining to the urban resilience agenda, which in turn informs policies, funding and financing mechanisms. More often than not, urban resilience and relevant urban development publications begin with all-too-known statistics on the projected rate of urbanization. According to the United Nations, for the first time in human history, the planet's population living in cities exceeded those living in rural areas in 2007, with a 54% global urban population estimated in 2014. Projections predict that by 2050, 66% of the world's population will be living in urban settings (UNDESA, 2022). Taking into account the estimated rise in global population by 2.4 billion people by 2050, it can be estimated that urban settlements will expand by approximately 51% over a span of 35 years, starting from 2015.[2] In other words, more than half of the expected urbanization has not taken place yet.

[2] The UN method to project city populations is based on the last observed city growth rate, which converges toward an expected value. This expected value is estimated on the basis of the city population and the growth rate of the overall urban population in a given country, similar to the methodology utilized for the projection of the urban-rural growth differential.

To further understand the statistics based on available statistical data and estimations from 2015 and 2022, the global population was estimated to be 7.3 billion in 2015. By November 2022, it reached 8 billion and is projected to reach 9.7 billion by 2050. Of these, about 4 billion people lived in cities in 2015. This number is expected to reach approximately 6.4 billion in 2050, accounting for more than 50% urban growth over a span of 35 years. Such rapid and unprecedented urbanization, as expected, entails significant and overbearing consequences if unchecked. For the first time, cities will be the central hub of human activity; however, high concentration of people signifies a multiplication of social risks exacerbated by intensified climatic phenomena. The United Nations Paris Agreement on Climate Change, which entered into force in November 2016, recognized both the risks and impacts of climate change as well as acknowledged the significance of the engagement of all levels of government and various actors, emphasizing both "the intrinsic relationship that climate change actions, responses and impacts have with equitable access to sustainable development and eradication of poverty" (UNFCCC, 2015). The results of the risks involved are manifested in the financial, infrastructure, and human losses registered during intensified crises. The risk, however, does not necessarily increase exponentially with the recurrence of potential events but is instead linked to the magnitude and the degree of human social vulnerability.

The upward trend in crisis and damage is also evident. According to the European Environmental Agency (EEA, 2023), the variations in reported economic loss over time are difficult to interpret because more than 70% of the losses were caused by only 3% of all registered events. However, by 2020, 80% of the economic losses were attributed to natural hazards in the EEA member states. In the US, the annual average of events from 1980 to 2016 was 5.5. This average has steadily increased since then. For example, in the 2012–2016 period, the average was 10.6 events, which is already double of average recorded for the overall period between 1980 and 2016. In 2017, the total losses exceeded US$ 15 billion, and from 2018 to 2022, the average rose to 17.8 events per year, with a total cost of more than US$ 600 billion. In 2023 (as of July 11), 12 confirmed weather/climate disaster events have affected the US, with losses exceeding US$ 1 billion each (National Centers for Environmental

Information NCEI, 2023). It is important to stress that from a disaster point of view, population growth and patterns of economic development are more significant factors.

Disaster is a human-centered term and is employed when a phenomenon affects humanity. According to the Sendai Framework Terminology on Disaster Risk Reduction, disaster is defined as follows:

> A serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to one or more of the following: human, material, economic and environmental losses and impacts. (UNDRR, 2017)

Rapidly expanded cities built in unfit areas signify higher population density, partly explaining the recorded increase in human deaths globally despite less people being affected in absolute numbers—a potentially misleading statistic (CRED, 2022). In 2022, Europe topped the death toll charts with 16,305 deaths reported by the Centre for Research on the Epidemiology of Disasters, while this number is reported in a most recent study as fivefold higher (Ballester et al., 2023)

In urban settlements, climate change is directly responsible for adverse effects on health and infrastructure as well as for the increasing frequency of both sudden and slow-onset occurrences.[3] Once we start linking the available data on the aggregated cost of natural disasters to the expected exponential growth of cities and the rising vulnerability of and inequity faced by populations living in informal urban settlements, the relation between unchecked urbanization and climate change as a fundamental factor in the formation of urban resilience policies is painted. The urban dimension of climate change adaptation and mitigation in the context of governance can be located in the cumulative effect of the negative or positive impact of relevant policies on the world's urban centers. If cities are not strengthened, the inherent disaster risk is too big for any single actor to manage. This risk includes both direct potential losses in the actual affected areas and unintended consequences that could ripple

[3] This observation has been reported with "high" confidence in both IPCC reports published in 2022 and 2023 (Climate Change 2023, synthesis report of the IPCC sixth assessment report [AR6], p. 8 & 16).

across the world as a result of a local disaster that is inadequately managed, given the interconnected nature of the globe today.[4] Losses are closely connected to the degree of development and income as well as to risk, which increases when there is a high degree of urbanization and investment in disaster-prone areas. Any type of bias in decision-making or even risk perception can lead to uncontrolled destruction. This underscores the need for public action, particularly in support of the most vulnerable populations (Hallegatte, 2013).

In other words, existing resources in a given urban setting are not nearly enough to tackle parallel shocks in expanded urban centers. Moreover, these same disasters may have far-reaching consequences across different time periods and geographical locations as a result of globalization (or interdependence).

It could be argued that globalization (also viewed today as multipolarity and interdependence) is a third pillar in terms of the global dynamics that are shaping the urban resilience practice. Interestingly, when it comes to this particular mega-trend, recent evidence suggests that we are entering a low-cooperation era (Gaub, 2019; Naughtin et al., 2022). Globalization and interdependence are critical to the success of global urban resilience-building efforts, which require common action. Nevertheless, "the lack of deep, concerted progress on climate targets has exposed the divergence between what is scientifically necessary to achieve net zero and what is politically feasible" (WEF, 2023). Furthermore, growing divergence between advanced and developing countries has been recorded in multiple ways over the past five years, accounted for the purposes of this chapter. There are inequalities in adjustment demands, both among smaller nations even within continents and between historic polluters and countries most disproportionately affected (Economides et al., 2018). The particular disparity was practically acknowledged in the adoption of the COP2027 agreement for the creation of a "Loss and Damage Fund" for vulnerable countries hit by climate disasters and was further

[4] The Atlas of Disaster produced by Rebuild by Design (Chester & Lawton, 2022) is an excellent research and data resource demonstrating the particular correlations in the US.

highlighted during the proceedings of the global UN-Habitat Assembly in Kenya in June 2023.[5]

Similar to disasters, which are anthropogenic in their conceptual definition, the concept of globalization can be viewed as the most abstract description of the myriad links constituting a global network of systems with urban centers as powerful nodes. Globalization, as a multidimensional historic phenomenon (Antunes & Fatah-Black, 2016), ultimately becomes relevant to the conversation on urban development and resilience by virtue of its quality of signifying interconnectivity. It is this interconnected nature of the global system that exacerbates risks at the domestic level (WEF, 2017). Conversely, it also presents a significant opportunity for redefining human interactions, shocks, and stresses that manifest at different scales within urban settlements, all of which are directly connected to globalization trends (Landry, 2016).

Within the context of the above-highlighted mega-trends, three recent global events seemingly unrelated to urban resilience, namely, the double refugee crisis in Europe's periphery over the last eight years that has its roots in Syria and Ukraine, the outbreak of the COVID-19 global pandemic, and the most recently elevated stress of urban heat, have rapidly brought forward the association between long-term urban resilience and twenty-first-century shocks and stresses in the most urgent manner. These particular occurrences are notable from an urban practitioner's perspective because they have had a rapid international ripple effect, are ongoing in nature, and are directly linked to the forward-looking mega-trends that are shaping the urban resilience discourse.

The Syrian refugee crisis that started in 2015 and the latest unprecedented flow of refugees from Ukraine are examples of processes exacerbating the connection between urbanization and globalization, both in terms of the management of an actual crisis and in its spillover effects. For example, in absolute numbers, the Syrian refugee crisis instigated only a 1% increase in the regular migration flows in Europe in 2015; however, its effects were disproportionally felt at the local city level, causing

[5] The "Loss and Damage" fund was announced in autumn 2022, with a first transitional committee established in March 2023 to make recommendations for consideration and adoption by COP28 and CMA 5. See: https://unfccc.int/topics/adaptation-and-resilience/groups-committees/transitional-committee (Last accessed on 30/07/2023)

multiple global waves of reaction across Europe, Asia, and the US (George Kaminis, personal communication, April 10, 2023). This human-induced urban crisis highlighted the key role of cities as intermediate policy actors as well as their vulnerability, exacerbated by their limited organizational capacity, lack of relevant political authority, and absence of appropriate tools and knowledge to provide short- and long-term solutions to what is effectively a minor shift in human flows but exerted a substantial disruptive impact at the local level.[6]

In a similar fashion, the COVID-19 pandemic and the subsequent lockdowns and restrictive measures that primarily unfolded in cities brought forth safety and security as a mega-trend in global urban affairs, with many cities diverting their attention to enhancing their capabilities to manage public spaces and support citizens' lives. This development challenged the global urban practice and the political consensus surrounding urban development. In the aftermath of COVID-19, cities have invested significantly in re-evaluating their approach to the "Urban Commons" in this era marked by concerns about public health and other emergencies. This re-evaluation is driven by the acknowledgment that citizen vulnerability is higher in locations where public spaces are limited, and that a correlation exists between limited access to safe public spaces and economic and socially disadvantaged urban areas. Characteristically, the European Union-led Urban Innovative Actions Program (currently incorporated within the European Urban Initiative) co-invested 55 million euros in a span of three years into addressing the issue of public space vulnerability alone.[7]

Third, the most recent emerging risk in terms of urban development and resilience is urban heat. While certainly not a novel conversation,

[6] This conclusion was reached at the global meeting on Cities and Migration organized by 100 Resilient Cities in Athens, Greece, in September 2016. This meeting saw the participation of cities, experts, international NGOs, and other actors working in the fields of migration and urban resilience. The report is available at https://resilientcitiesnetwork.org/downloadable_resources/UR/Global-Migration-Resilient-Cities-At-The-Forefront.pdf. The European mayors' declaration on refugees in 2016 (Cities of Solidarity) is another primary source highlighting this conclusion.

[7] Since 2020, several practitioner- and academic-led publications recording the various frontline city responses to COVID-19 have been made available, with characteristic critical resources including (in chronological order) the OECD (2020) Cities policy responses, the UN-Habitat COVID-19 urban data resource (https://data.unhabitat.org/pages/covid-19), the report on Next Generation EU cities (Boni & Zevi, 2021), and the research by O'Herlihy et al. (2023).

considering scientists have been highlighting urban heat island effect as an urban development risk for at least 15 years (Stathopoulou & Cartalis, 2007), the increasing exposure to more frequent extreme heat days as a direct consequence of climate change has led international and multilateral entities to prioritize urban extreme heat as a critical shock and policy focus when it comes to mainstreaming urban climate action. This particular risk is predominantly faced by urban centers around the Mediterranean basin, which is considered a climate change hotspot (Ali et al., 2022). A collaborative study led by Columbia University indicates that Tel Aviv-Yafo in Israel is expected to experience over the next decade two additional months of temperatures exceeding 43 °C and an additional ten days of heat waves. On the other side of the Mediterranean, Sevilla in Spain is expecting the mean temperature to increase by 4.5 °C and an increase in annual heat waves, with temperatures that may exceed 50 °C (Karydi, 2020).

These three typical crises of the past eight years, combined with the mega-trends affecting the urban resilience policy discourse, have emphasized in the most tangible manner the key role of cities not only in crisis management but also as essential actors in the effective implementation of critical integration and cohesion policies (Dimitriadi & Sarantaki, 2018). These crises have exposed a critical issue in contemporary city systems, namely, the lack of flexible response mechanisms to address unforeseen changes, highlighting, in turn, the need to systemically build urban resilience.

So, What Is Urban Resilience?

Building on C.S. Holling's (1973) ecological resilience argument, which posits that systems are in a constant state of disequilibrium, the growing urban resilience literature, in contrast to the previously established "sustainability agenda," aspires to offer policymakers the flexibility and tools for rapidly restoring order in the face of disasters while minimizing the crisis impact on vulnerable and poor populations and actively identifying opportunities for growth and innovation in the process. From a change management perspective, this evolution has gained traction, especially in contexts where city staff and local elected representatives often tend to approach the process of resilience building from the starting point of being "already resilient," which is based on the argument that cities have been surviving disasters and catastrophes for centuries. Is there a consensus or a common framework on the understanding of "urban resilience" in the twenty-first century?

Tracing the evolution of the definition of urban resilience in research and practical applications, it is observed that the concept has evolved from the acknowledgment that "resilience is about learning to live with the spectrum of risks that exist at the interface between people, the economy and the environment"[8] to a more active recognition that urban resilience is effectively about securing and improving lives and livelihoods.[9] The current approach to urban resilience emphasizes that even if individual systems are sustainable, the overall resilience of a system of systems is crucial. Without resilience at the systemic level, even a sustainable system will collapse from external shocks or will implode from long-endured pressures (stresses). This evolved understanding seems to have emerged following the theoretical progression in the application of the term "urban resilience," moving from "engineering resilience" to "systems resilience" and then eventually to "resilience in complex adaptive systems" (Martin-Breen & Anderies, 2011). Each stage in this evolution builds upon previous understanding, with the definition first referring to the ability to effectively bounce back from disaster and then integrating the capacity to recognize, accept, and adapt to change whether it is rapid or slow (shocks/stresses, respectively). Finally, the definition encompasses the ability of various systems to adapt to and produce new variables. This central dimension of the urban resilience approach offers an understanding of the urban system by focusing on its ability to withstand crises and thrive even during such adverse circumstances and, above all, maintain a

[8] This is the definition put forth by GFDRR after the facility's establishment in 2006.

[9] This definition represents the condensed "minimum common denominator" definition adopted by the organizations involved in the Medellin Collaboration.

transformative quality when responding to potentially agnostic human-ecological challenges.[10]

Nevertheless, after analyzing a range of definitions, it becomes evident that resilience remains a broad concept as it constitutes both an end goal in itself and a method for building sustainable, inclusive, and prepared cities. This becomes clear when one attempts to identify and contextualize the available definitions. While there is a mention of resilience and its characteristics, defining resilience itself proves to be challenging. In the probable absence of evidence-based research, the approach to understanding resilience is to a large extent functional.[11]

Central global entities and existing literature provide different definitions of and approaches to urban resilience (Table 6.1), yet there is a consensus that addressing disaster shocks must also involve dealing with long-term stresses to prevent city failure and promote growth.

In other words, from the starting point of risk disaster management, the consensus is gradually moving toward an understanding of urban resilience as a holistic, forward-looking, and inclusive development goal. However, disaster risk management continues to remain the central reference point (Benczur et al., 2017).

The Medellin Collaboration has helped large global organizations reach a basic agreement on the minimum definition of urban resilience as a holistic mechanism of urban management that encompasses social and physical spheres beyond disaster risk management. Meanwhile, governments and other relevant governmental bodies in Europe still largely understand resilience as principally a mechanism for disaster risk reduction.[12] On the contrary, the academic approach seems to attempt to offer

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[10] "Hence, resilience, as in focus here, is a dynamic concept concerned with navigating complexity, uncertainty, and change across levels and scales (e.g., Berkes et al., 2003; Cash et al., 2006; Cumming et al., 2013) on a human-dominated planet (e.g., Lubchenco, 1998; Steffen et al., 2007)" in Folke (2016, p. 48).

[11] Refer to a review of the resilience literature in Meerow et al. (2016).

[12] The Scottish government is a characteristic example where a well-organized department and policy exists on resilience, with supporting departments delivering emergency planning and response. The Scottish government collaborated with the city of Glasgow as a pioneer urban resilience city between 2017 and 2019, focusing on a social resilience agenda. Glasgow is among the first cities in Europe to depart from the more established risk and disaster management approach on resilience.

Table 6.1 Definitions of resilience and their key characteristics

Global organizations' definitions of resilience	Key characteristics of resilient systems
OECD: Resilience involves the ability to absorb, adapt, transform, and prepare for the past and future impacts of economic, environmental, social, and institutional shocks and stresses	Adaptive capacity, robustness, redundancy, flexibility, resourcefulness, inclusiveness, and integration
World Bank: The ability of a system, entity, community, or person to adapt to a variety of changing conditions and to withstand shocks while still maintaining its essential functions	Adapt, withstand, endure
Resilient Cities Network: Urban resilience is the capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and grow, no matter what kinds of chronic stresses and acute shocks they experience	Robust, redundant, reflective, resourceful, inclusive, integrated, flexible
UN-Habitat: Resilience refers to the ability of human settlements to withstand and recover quickly from any plausible hazards. Resilience against crises refers not only to the capacity to reduce risks and damage from disasters (i.e., loss of lives and assets) but also to the ability to quickly bounce back to a stable state	Withstand, recover, bounce back
Resilient Cities Catalyst: The capacity of individuals, communities, institutions, and systems exposed to hazards to survive, adapt, and thrive in ways that improve outcomes in the next disaster event and improve community well-being more broadly	Robust, inclusive, integrated, reflective, accountable
UNSDIR: The ability of a system, community, or society exposed to hazards to resist, absorb, accommodate, adapt to, transform, and recover from the effects of a hazard in a timely and efficient manner through the preservation and restoration of its essential basic structures and functions utilizing risk management	Resist, absorb, accommodate, adapt, transform, recover
ICLEI: A "resilient city" is prepared to absorb and recover from any shock or stress while maintaining its essential functions, structures, and identity, as well as adapt and thrive in the face of continual change	Absorb, recover, endure, adapt, thrive

(*continued*)

Table 6.1 (continued)

Global organizations' definitions of resilience	Key characteristics of resilient systems
EU ECHO: Resilience is the ability of an individual, a community, or a country to cope, adapt, and quickly recover from stress and shocks caused by a disaster, violence, or conflict	Cope, adapt, recover from stresses and shocks
EU JRC: The ability of a system (or a society) to face shocks and persistent structural changes in such a manner that it keeps on delivering societal well-being without compromising the same for future generations	Reflective, flexible, inclusive, robust

a comprehensive, "all-inclusive" definition to urban resilience in which "Urban resilience refers to the ability of an urban system—and all its constituent socio-ecological and socio-technical networks across temporal and spatial scales—to maintain or rapidly return to desired functions in the face of a disturbance, to adapt to change, and to quickly transform systems that limit current or future adaptive capacity" (Meerow et al., 2016, p. 45).

In the Investing in Urban Resilience report, the World Bank Group urged for investment into fortifying cities against the impact of climate change and natural disasters, recognizing that such investments will not only enable cities to cope with a wide range of shocks and stresses but also enable them to approach resilience as the ability of a system, entity, community, or person to adapt to various changing conditions and withstand shocks while still maintaining its essential functions (World Bank Group, 2016). While this approach acknowledges the adaptive capacity of a resilient system, the focus is still more on the capacity of a system for mitigation and better disaster prevention management. Thus, in the context of this approach, social resilience becomes a means to an end rather than an end goal in itself. In other words, the World Bank recognizes the need to invest in urban resilience as a prevention mechanism, yet what seems to be absent is the focus on innovation and aggregation of solutions (i.e., social/private market drivers), which is found in other definitions of urban resilience such as those presented by the former100 Resilient Cities of the Rockefeller foundation program or OECD. The hypothesis rather is that “if all countries implemented a ‘resilience package’, the gain in well-being would be equivalent to an increase in national income of billions per year” (World Bank Group, 2016, p. 14), where resilience package refers to better financial inclusion, disaster risk and livelihood insurance, scalable safety nets and increased social protection coverage, contingency finance and reserve funds, and universal access to early warning systems.

Language barrier presents a significant challenge in the achievement of a true common understanding of resilience as a strategic mechanism. When translating the term in languages other than English, it often veers away from the concept of a proactive, strengthened society capable of dealing with various risks and instead moves closer to its primary “inelastic” conceptualization as “resistance” to disasters. Through the former 100 Resilient Cities, pioneered by the Rockefeller Foundation, and the current Resilient Cities Catalyst and Resilient Cities Network, a consistent understanding of urban resilience had been mainstreamed across the world. However, the linguistic diversity across regions renders achieving a consistent understanding of urban resilience a challenging endeavor. The common understanding in this case had been facilitated through the adoption of a primary common methodology of engagement based on a shared strategy manual, uniform training of urban practitioners training on resilience, and the parallel development of a consistent program in multiple locations around the world. The dynamics of such an approach has been unprecedented and difficult to repeat, underscoring once again the importance of a functional definition of resilience that focuses on its commonly agreed characteristics rather than on the term itself.

Urban Resilience and Urban Institutional Changes in Tampere and Beyond

In a period when, even today, with increasing complexity, there are numerous unknowns in the mapping of the ways in which the multidimensional parts of the world fit together (Barabási, 2014, p. 5), an effort to globalize the resilience discourse by creating a consistent terminology and identifying potential indicators could constitute a massive evolution, creating a tangible opportunity to "unpack" the otherwise intricate urban systems. Acknowledging that risks at the local level hold the potential of inherent global consequences, this possibility could be groundbreaking. Building on the contemporary understanding of the relation between urban growth and risk, current urban resilience-building methodologies are apparently increasingly offered as a means to counter the prevailing tendency toward over-simplification in crisis management, which is especially predominant in the national and subnational civil protection mechanisms.

While the causes and effects of globalization, climate change, and urbanization can be understood as three factors underlying the urgency to build city resilience, this fourth dimension, namely, the necessity to change the management system of cities, arguably constitutes a unique goal for resilience-building efforts and defines the difference between disaster risk management and holistic resilience approaches.[13]

If cities need to change to be able to cope with "glocal" challenges in the face of growing pressures that they cannot afford to ignore, then they should be able to strategize, engage in long-term planning, and implement programs that directly address their management deficit in a multidimensional manner. This complex fourth helical dimension is also reflected in the theoretical models of the driver-pressure-state-impact-response (DPSIR), which can be applied to the urban resilience policy context if studied further.[14] Initially evolved from the climate and environmental policy agendas, DPSIR models are intended to primarily provide a framework for the representation of interactions within an urban ecosystem and the feedback from those interactions, especially in the absence of a comprehensive theory explaining the phenomenon to be

[13] The UN Sendai Framework 2015–2030 for Disaster Risk Reduction sets seven targets for achieving disaster risk reduction. Notably, it emphasizes the need to prioritize the strengthening of the disaster risk governance system as well as highlights the target of "investing" in resilience.

[14] This model has been adopted by the European Environmental Agency http://www.eea.europa.eu/publications/92-9167-059-6-sum/page002.html (Accessed on 3/8/2023).

analyzed.[15] The approach has also arguably been reflected in the efforts to construct a novel public management model that captures the multidimensionality of the networked system of governance (Bourgone, 2011). Evidently, this theoretical framework becomes more tangible in the evaluation of the urban institutional transformation processes currently taking place around the world.

The end goal of building urban resilience is to help cities develop horizontal, forward-looking, fact-based, and project-oriented initiatives that will drive cities in the twenty-first century, will improve quality of life holistically, and will allow cities to innovate when addressing risks. Underlying this process is the idea of dismantling government silos, enabling cities to exercise strategic planning, and empowering them to deal effectively with the "glocal" shocks they face.

A growing number of cities across the world have been adapting their governance models to include the position of a Chief Resilience Officer or a resilience department to become better equipped in understanding the following:

1. How global risks and trends, along with existing hazards/shocks and underlying stresses, are exerting an impact at the local level [risk assessment]
2. The capacity of businesses, government, and the community to manage these changes in the context of city aspirations (and particularly the institutional barriers to adapting to these changes, such as rules and practices, culture, norms, politics and policies, and the like) [Institutional Assessment and Alignment]
3. The strategies and actions, locally generated or learnt from global sharing that can be implemented through a forward-looking, project focused and data driven appoach.

[15] "This systems perspective suggests that economic and social development, which are common driving forces (D), exert pressure (P) on the environment and as a result the state (S) of the environment changes. These changes then have impacts (I) on ecosystems, human health and other factors. Due to these impacts, society responds (R) to the driving forces, or directly to the pressure, state, or impacts through preventive, adaptive, or curative solutions" (Ferrao & Fernandez, 2013, pp. 15–16).

Tampere is the first city in Finland to be following the global trend of approaching global risks systemically in its ongoing considerations for establishing a resilience department and embedding resilience officers within its administrative structure to address the deep-cutting need of informing foresight through data, risk mitigation, and crisis management in a holistic manner. To this effect, and within the context of the Urban Innovative Actions-funded SURE program, Tampere became the first city in Finland to become a signatory to the Making Cities Resilient Campaign 2030, pledging to implement a resilience-building process within the city. In this respect, two significant and highly relevant dimensions of SURE as a service need to be noted. First, it includes the development and application of a change management process to increase the capacity and efficient horizontal collaboration between traditional safety and security actors such as the fire department, event management stakeholders, municipal services, and citizens. Second, it includes the incorporation of provisions for collecting and understanding forward-looking data to inform strategic development and planning in correlation to the city's strategic priorities.

In this respect, SURE in Tampere represents a characteristic example of the gradual embedment of urban resilience within a city structure, as the following chapters aim to demonstrate.

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7

Crowd Counting in Action: Observations from the SURE Project

Henry Joutsijoki and Sari Mäenpää

Introduction

World's population has exceeded the limit of eight billion. Kuddus et al. (2020) stated UN's estimate that in 2019, over half of the world's population lived in urban areas, and by 2041, six billion people may live in urban areas. This societal transition, also known as urbanization, has immediate consequences. From a global perspective, urbanization can lead to problems in terms of inequality and health issues, both in developed and developing countries (Kuddus et al., 2020). When large masses of people move to urban areas, inequality in living conditions may arise, since cities often lack the resources to standardize housing for all residents. Consequently, disparity among citizens increases, and slums or suburbs with "bad reputation" may emerge. Less than optimal living conditions may exert a direct impact on inhabitants' health, and, for instance,

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communicable diseases can spread faster, especially within large crowds, significantly burdening the public health system (Kuddus et al., 2020).

The emergence of housing, health, financial, or other personal problems may easily lead to criminal activities. The consequence of criminal and other life-endangering activities is that the level of public safety declines. The impact of these activities extends beyond individuals and, hence, must be considered on a larger scale, encompassing events, critical infrastructure, public spaces, workplaces, home, and other personal properties, among other aspects. How can the challenges regarding public safety be responded to, preferably through preventive measures, is a focal question to be answered. We have several authorities (e.g., police) and non-authorities (e.g., private security companies) whose main purpose is to maintain the safety and security of citizens; however, the number of people working in this field is limited. This is why we require some additional tools that can help us prevent certain cases from occurring and enhance the efficiency of solving cases that have already happened.

One means of improving safety- and security-related situational awareness is by leveraging camera-based technology. The ubiquity of cameras has led to a situation where camera prices have gone down and the technology utilized in cameras has developed rapidly. This has enabled companies, organizations, and cities to invest in camera technologies and improve their preparedness for unexpected situations. Moreover, companies, organizations, and cities have designed services and intelligent platforms toward building smarter cities where the capabilities of IoT, smart cameras, and other devices can be connected.

The commonness of cameras can be gleaned from the amount of data collected from these devices. Applications often have multiple cameras installed, with large volumes of multi-modal data (combination of sound and image) flowing through these cameras. Data constitutes the foundation for applications in which raw data is refined into knowledge and wisdom. Extracting valuable information from multi-modal video data requires computational techniques related to machine learning and computer vision, both components of artificial intelligence (AI).

The processing of large-scale video data can be tricky and may require significant computational resources, especially if the analysis is being performed in real time. Camera-based data has numerous applications such as crowd counting, object detection, face recognition, anomaly detection, or human pose estimation. All of these applications can be placed under the umbrella of camera surveillance, with each providing a unique perspective to it. In addition to technical issues, there are other aspects that should be considered as well when performing camera-based data analysis due to the sensitivity of the data. Privacy issues need to be addressed beforehand since the GDPR (European Union, 2016) and national laws have put into practice regulations pertaining to who can process data, what types of data can be processed, and the methods through which the processing can be performed.

Camera surveillance itself is an extensive topic, and, in this chapter, the focus is placed on a single application called crowd counting. In the SURE project, crowd counting was selected for conducting in-depth examinations following a thorough assessment of the requirements identified by the authorities and other relevant stakeholders. Crowd counting can be considered as a special form of general object detection in which predefined classes (e.g., car) are detected from images. The basic objective of crowd counting is to estimate the number of people in an image or the density of people in a specific area. When a multitude of surveillance cameras are in use, relying solely on human monitoring becomes impractical and inefficient. This is where machine learning/AI methods can be employed to flag abnormal events for the operator.

Different cultural, sporting, and music events are an integral component of society. Events bring extra visibility as well as income for a city. Depending on the nature of the event, it can draw large crowds, potentially leading to security threats. Before the COVID-19 pandemic, various events were organized regularly; however, COVID-19 changed things, with a majority of face-to-face events getting canceled and traveling from one place to another becoming restricted. From the crowd counting point of view, COVID-19 presented possibilities, as crowd counting algorithms could be utilized as an initial step in crowd monitoring and social distance estimation (Al-Sa'd et al., 2022; Gonzalez-Trejo et al., 2022). After two years of struggling with COVID-19, the world is gradually reopening, and the original purpose of crowd counting remains relevant. Crowd counting has several use cases that provide value in terms of safety and security, business operations, or cost savings.

Numerous algorithms for crowd counting have been developed, and new algorithms are being actively developed at present. Research in this field has primarily concentrated on algorithm development, and a common process highlighted crowd counting studies include the following:

1. Developing a deep learning solution by modifying an existing architecture through the addition of new module/modules to it.
2. Evaluating the solution with some publicly available crowd counting datasets.
3. Comparing the results with those of previously published methods and the outcomes presented in the studies that have tested the same datasets.

Additional research is required to address the requirements for deploying a crowd counting solution. Algorithm development is the last component in a long pipeline. Before conducting the actual crowd counting and receiving the results, the following steps need to be taken:

1. Defining environment requirements and the use case
2. Defining camera and integration requirements
3. Defining computing environment and privacy requirements
4. Defining data and algorithm requirements

This chapter aims to provide an overview of the practical challenges that are encountered during the implementation of a crowd counting solution. The purpose of this chapter is to present general guidelines pertaining to the issues that should be considered when implementing a crowd counting solution in practical applications.

The target audience of this chapter is diverse, and it attempts to act as a bridge between two different "worlds," namely, management and technology. Data scientists and analysts have a robust understanding of the predictive modeling and algorithms that produce the final output, that is, crowd count from image or video data. However, data scientists and analysts usually take the data as granted and may not have extensive knowledge about the pre-data phases such as installation of cameras or the legal constraints related to camera monitoring. Hence, data scientists can extend their knowledge and understanding beyond data. Data engineers, on the other hand, focus on constructing the data pipeline from data sources to servers or cloud platforms, and laying the foundation for data scientists. Compared with data scientists or engineers, policymakers, event organizers, and planners face the opposite situation. They possess a vision and have an understanding of the practical needs. These stakeholders also have a firm grasp over reality and know how things work in practice; however, they often lack knowledge on technology-oriented topics as well as constraints and requirements pertaining to data and algorithm.

In the SURE project, Insta Advance has examined crowd counting in the Tampere city environment. Several city cameras have been integrated into the map-based Insta Blue Aware (IBA) situation awareness platform. A deep learning crowd counting solution was developed on top of the IBA platform to estimate the crowd count from video stream. The estimate was stored in a database, making it possible to follow trends in crowd count. In the implementation phase, we encountered many practical challenges that have been covered in the following sections. Moreover, it was noticed how sensitive a task it is to select the right kind of training set for the machine learning method. Furthermore, constructing the pipeline was not a straightforward task, despite it being a simplified version compared with the solution that would be in production use. The experiences gained from the SURE project strengthened our knowledge about the challenges of implementing a crowd counting solution. Of course, many commercial solutions are available; however, by opting for them, the consumer then becomes tied to the manufacturer's solution and must adapt to the constraints. Building a crowd counting solution from scratch certainly takes more time and resources; however, it satisfies the needs of the customer.

Camera and Space Requirements

Camera-based crowd counting is one of the many applications of camera surveillance. Implementing a camera surveillance system is a multi-staged process in which nine main steps need to be performed, according to Arenius et al. (2020). Examining all these steps with in-depth precision is beyond the scope of this chapter, since Arenius et al. (2020) have already covered these topics extensively in their camera surveillance guide. In the following, we focus on topics that are essential to the implementation of a crowd counting solution more from technical point of view and, specifically, from a data perspective.

Camera Type Selection

A wide range of camera types is available, and camera selection depends on the use case. Some camera types are designed for either indoor or outdoor use, whereas some can be used in both scenarios. Arenius et al. (2020) have presented short descriptions of the most common surveillance camera types, delineating their specific features. Drawing from their study, the main characteristics of the most important camera types in the context of crowd counting are summarized as follows:

1. Bullet and hull cameras are those that monitor a fixed image area. They can be used both indoors and outdoors; however, when using outdoors, the camera should be protected with necessary boxing to prevent malfunctions caused by vandalism or weather conditions. Bullet cameras may also possess analytical properties.
2. Dome cameras' properties and usages are similar to that of hull cameras. However, dome cameras are not as noticeable as a regular fixed camera. Dome cameras are available for both indoor and outdoor use, and those designed for outdoor use come protected. Moreover, some models offer a fish-eye version to provide a 360-degree view.
3. Pan Tilt Zoom (PTZ) cameras are utilized for monitoring indoor and outdoor spaces. Boxed/protected versions of these cameras are also available, and they are capable of monitoring details from long distances because of their adjustable zoom property. PTZ cameras can be programmed to monitor specified areas following a predefined schedule.

Camera type selection is the first step in the implementation of a crowd counting solution. In addition, consideration of technical details is critical to ensure that the camera produces good enough data for the algorithm. Resolution, night vision capability, zoom property, and possible built-in AI features are details that need to be checked so that they correspond to the requirements of the space to be monitored. The camera serves as the main data source for the algorithm to evaluate the crowd count. To ensure the best possible estimation result, technical features must be compatible with the needs. If the data quality is poor, even the most intelligent algorithm cannot provide a reliable estimate for crowd count. On the other hand, if the camera produces high-quality data with high resolution, the output will need to be downscaled so that the analysis can be performed in a reasonable time. Built-in AI properties are interesting since in best-case scenarios, they can provide the crowd count automatically, which solves many practical problems. Furthermore, maintenance of cameras must be taken care of to ensure that they produce good quality data at all times.

Camera Placement

One of the steps in implementing camera surveillance involves creating a placement plan for the cameras (see Arenius et al., 2020). This step is an essential component of the implementation of a crowd counting solution since the positioning of cameras greatly influences the data the cameras will produce. The first thing to decide is the actual location of the cameras, which, in turn, will determine how the monitored area will be covered. Here the use case and motivation for crowd counting and/or camera surveillance play a key role. If the use case is to count the number of customers entering and exiting a supermarket, deciding the location of the camera is easy, since the camera would naturally be placed above the entrance. Furthermore, the number of cameras would be equal to the number of entrances in the supermarket.

The situation is different when a large outdoor space requires monitoring. In this case, determining the number of cameras and their placement is not so simple. The goal of optimally positioning cameras is to minimize dead spaces that none of the cameras can reach and avoid overlapping camera areas. Cameras' dead spaces can influence public safety in an area, and they also lead to an underestimation of the crowd count. Overlapping areas, on the other hand, overestimate the overall crowd count, since the same individuals get included in several of the images from which the crowd count is estimated.

Once the locations of the cameras have been decided, the installment height determines many factors regarding the crowd count. When the camera is installed at a low height, it can capture close-up images of the crowd, which allows for better counting of individuals in a frame. On the other hand, cameras installed at higher heights can capture larger crowds in a single frame, but individual people may not be easily recognizable in these images. The distance from which the images have been taken influences the selection of crowd counting algorithm, since not all algorithms are suitable for analyzing images taken from a long/short distance. Furthermore, the decision to use zoom or change the angle view should be made beforehand. This is because if an algorithm is fine-tuned to evaluate the crowd count from images taken from a specific distance, zooming or changing the angle view might disrupt the algorithm and deteriorate the accuracy of the crowd count estimate. The monitoring distance also has implications for privacy issues especially regarding the identification of individuals. If people are being monitored, they should be made aware of it through, for example, a sign notifying them of the same. Furthermore, information about what is being done with the image data should also be communicated. If people can be identified from the images, regulations stipulated by the GDPR must be taken into account. Hence, it is necessary to consult authorities (e.g., police) and the legal department during the planning phase when the placement plan for the cameras is being created. From the privacy point of view, there is a significant difference between identifying individuals and providing a crowd count estimate based on the number of people present.

Computing Environment

Crowd count estimation by the algorithm is the final stage in the crowd counting implementation pipeline. However, before discussing this step, information needs to be provided on where the actual computational workload of the algorithm is executed. In this section, the focus is on the computing environment at a more general level. Furthermore, the basic challenges that should be covered in the planning phase are presented. Technical details such as different couplings are dismissed, and the following three primary alternatives are identified for where to perform the necessary computation:

1. AI cameras
2. Edge computing
3. Cloud services and on-premises solutions

Nowadays, many cameras are equipped with built-in AI features, which, in practice, usually denote the presence of some commonly utilized computer vision/object detection algorithm such as You Only Look Once (YOLO; Jiang et al., 2022) that can be employed to detect common objects. Detected objects are highlighted in the image/video with a bounding box and a label above it. AI cameras can be understood as a subset of edge computing, since the computation is performed immediately in the camera itself and the image is not submitted elsewhere for processing purposes. With AI cameras, the upside is that the algorithm does not need to be implemented if it meets the requirements of the use case. However, the downside with AI cameras is that the post-processing of analyzed images (e.g., extracting the crowd count from the camera, storing the result into a database, and the like) might be tied to specific commercial products/services provided by the camera manufacturer. In other words, a consumer cannot do anything with the camera without buying certain extra services or products. From the crowd counting point of view, this might create a privacy issue if the image data contains recognizable people, and if the images are from a sensitive area. Moreover, if the image data goes directly to the manufacturer's servers and is stored there, it may raise a security issue. If AI camera features allow consumers to integrate custom scripts into the camera that facilitate data transfer from the camera to external systems, it becomes possible to manage data without compromising security or privacy.

Edge computing differs from AI cameras in that the computing unit is not within the camera but in the immediate neighborhood of the camera. In edge computing, raw data received from the data source (i.e., the camera) is processed in the computing unit equipped with the necessary hardware. Only the result or processed data is sent for further examination (e.g., to the cloud or database). In the case of crowd counting, the camera produces images and the outer computing unit contains an algorithm that processes the input data. The crowd count is then transferred to a database or can be visualized, for example, in a control room. In edge computing, ensuring connectivity between the data source and the computing unit is critical. If the result/processed data needs to be sent further, seamless integration between the processing unit and the database and/or cloud environment is necessary. Integration work for building a "bridge" between the computing unit and the database/cloud environment can be laborious. When we are analyzing rather sensitive data where people can be identified, the use of a public cloud environment for storing the processed data may be problematic and in violation of the data protection and/or privacy regulations. Therefore, the on-premises option might be the only viable solution where data governance and management can be accurately specified.

Cloud computing is a third option for the crowd counting computing environment. In its case, the earlier mentioned privacy and data management considerations are critical aspects that need to be taken into account carefully. In a cloud environment, defining the exact location of the data is not necessarily easy, since the servers may locate the data in another country. If the data consists of sensitive information and cannot be transferred outside country borders, then the use of cloud computing services should be discussed with relevant authorities and the legal department in the planning phase itself. If cloud computing is employed for crowd counting, the first task that needs to be performed is the construction of the data pipeline between cameras and the cloud environment. The actual data processing algorithms can be implemented in the cloud environment, and the cloud provider's ready services and components can be utilized in the implementation. Cloud computing has its pros and cons. Cloud computing offers excellent scalability possibilities, which is necessary when the number of cameras for the crowd count estimation is large. However, the costing presents a downside, especially when several Graphics Processing Units (GPUs) are being simultaneously used in the cloud environment for image/video data analysis. Furthermore, there can be costs from data storage as well as analytic services. The cumulative cost of all services can be high. Moreover, data transfer from cameras to the cloud environment may be affected by latency that should be taken into account if the analysis needs to be performed in real time.

An on-premises solution presents an alternative to the use of public cloud providers. The benefit provided by this option is the ability to control data management. However, the costs of setting up the necessary infrastructure can be high, and the organization is also responsible of maintaining, renewing, and upscaling the hardware—all of which entail additional expenses compared with using public cloud services. Overall, all presented computing environment alternatives have advantages and disadvantages. The solution adopted depends on the organization's/company's use case, available resources, and the restrictions imposed by the regulations and legislation. A common factor among all alternatives is that they all require maintenance to some extent, and this must be remembered when implementing a crowd counting solution.

Categorizing Crowd Counting Methods

Image- or video-based crowd counting has been attracting researchers and practitioners for a long time. The earliest attempts to solve the pressing problem of crowd counting or more generally crowd analysis were recorded in the 1990s (Grant & Flynn, 2017). Since then, there has been a rapid and ongoing evolution in terms of computational methods. New research directions have been introduced over time, and the crowd counting methods today look very different compared with the methods utilized in the 1990s. In this section, the aim is not to provide a complete list and description of the methods that have been developed for crowd counting or crowd analysis. Instead, we will present a brief overview of the approaches that have been employed in crowd counting without going into the specifics of the methods. Detailed information about the methods can be found in the references cited.

Surveys by Zhan et al. (2008) and Silveira Jaques Junior and colleagues (2010) have covered the topic of crowd analysis through the employment of computer vision. Zhan et al. (2008) investigated topics pertaining to computer vision such as crowd density measurement, recognition (including face and head recognition and pedestrian and crowd recognition), tracking methodologies, and crowd modeling and events inference. Especially, pedestrian recognition can be considered an implicit application of crowd counting. Silveira Jaques Junior and colleagues (2010) adopted a twofold approach for crowd analysis: synthesis and analysis. The analysis part included three subcategories: people counting, people tracking, and behavior understanding. Figure 7.1 illustrates crowd counting, that is, the people counting approaches that Silveira Jaques Junior and colleagues (2010) covered in their study.

Grant and Flynn (2017) provided a more fine-grained division of crowd counting methods. In addition to the categories presented in Fig. 7.1 and by Silveira Jaques Junior and colleagues (2010), Grant and Flynn added line counting, density mapping, and joint detection and counting as distinct subcategories under crowd counting. All the categories can be viewed in Fig. 7.2.

The next step in the evolution of crowd counting methods is presented in Fig. 7.3. Ilyas et al. (2022) divided crowd counting methods into five categories, of which clustering constitutes an unsupervised method and the remaining categories are classified as supervised methods. Another way of categorizing these methods is by distinguishing them as traditional or advanced, as illustrated in Fig. 7.3. In this manner, all other categories except convolutional neural network (CNN) can be classified as traditional methods. Lamba and Nain (2017) and Loy et al. (2013) divided crowd counting methods into the categories of detection, clustering, and regression, which can be considered subsets illustrated in Fig. 7.3.

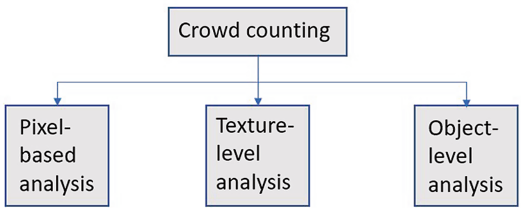

Fig. 7.1 A way to categorize crowd counting techniques. *Source*: Image adapted from Silveira Jaques Junior and colleagues (2010)

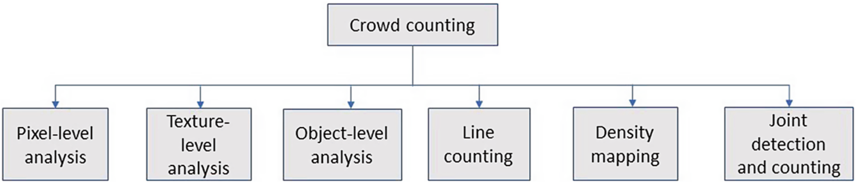

Fig. 7.2 Crowd counting techniques from Grant and Flynn (2017)

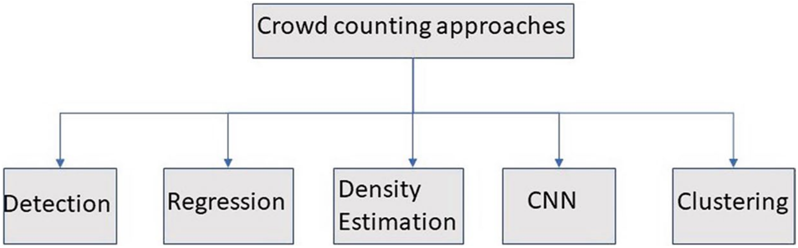

Fig. 7.3 Categorization of crowd counting techniques. *Source*: Image adapted from Ilyas et al. (2022)

Sindagi and Patel (2018) did not cover clustering methods in their survey. Hence, the categorization presented in Fig. 7.3 follows the current general categorization of crowd counting techniques.

CNN, illustrated in Fig. 7.4, represents the modern approach to crowd counting. Deep learning has shown great performance capabilities in many applications such as object detection and natural language processing (machine translation, text-to-speech applications, and the like), as well as in crowd counting. Recurrent neural networks, long short-term memory networks, and CNNs have become the standard approach to solve any task, since deep learning outperforms traditional approaches in many cases. In deep learning solutions, the downside is that they require a large amount of training data to build a reliable predictive model. The requirement of large training data can be met by employing pre-trained models that can be trained further with specialized smaller datasets.

CNN was also a starting point for the new categorization of crowd counting methods by Ilyas et al. (2022), which is presented in Fig. 7.5. Methods are divided into three primary categories (network-based,

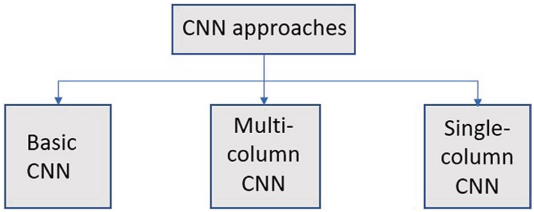

Fig. 7.4 CNN-based crowd counting techniques. *Source*: Image adapted from Hassen et al. (2022)

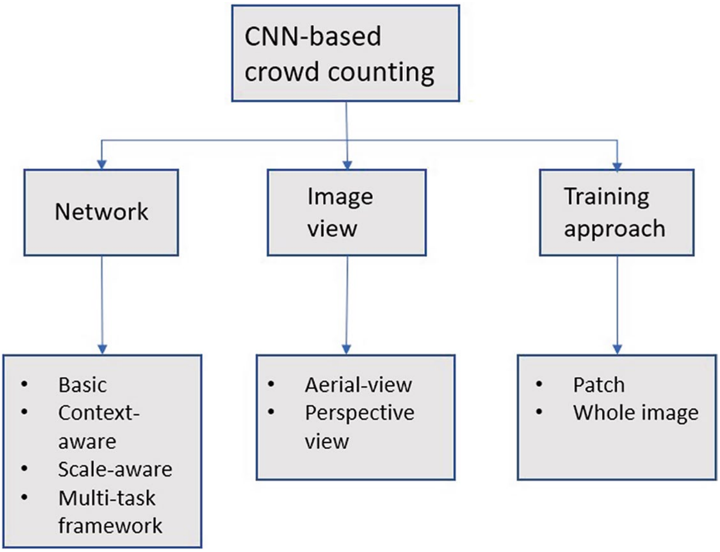

Fig. 7.5 A division of CNN-based crowd counting techniques. *Source*: Image adapted from Ilyas et al. (2022)

image-view-based, and training approach-based), and each of these categories include a collection of subcategories.

As demonstrated by the figures, the development of crowd counting has evolved significantly in the last decade. CNN-based approaches are currently the most popular, and this trend is expected to continue in the future.

Data Requirements

Now that a short overview has been provided on the categorization of crowd counting methods, in this section, the focus is on the requirements for the data needed to construct a crowd counting solution. As discussed above, crowd counting methods can be classified into different categories, and each one of these categories comprises several methods. The analysis is restricted to deep learning methods, which were of interest to the SURE project, and the requirements these techniques impose on the data. We divided data requirements into three components, and each of these components has been explored in the SURE project.

Data Annotation

In machine learning, supervised and unsupervised learning constitute the two primary learning paradigms. Deep learning-based crowd counting methods mainly belong to the supervised machine learning category. When a supervised algorithm is trained, the requirements are twofold. First, training data is required, from which the algorithm learns to recognize patterns/objects. Second, the training data must include ground truth labeling, which the algorithm utilizes in the training phase. The process of creating ground truth labels is known as annotation, and it can be highly time-consuming in practice since it is usually performed manually. For example, Wang et al. (2021) reported that the point-wise annotation process of the NWPU-Crowd dataset alone took 3,000 hours. Annotation is a delicate process since the annotation forms a basis for the algorithm's learning capabilities. Based on the annotation, the algorithm learns to identify or classify objects in an image. Annotation accuracy is of utmost importance in all supervised machine learning tasks. If the annotation includes mistakes, it causes the algorithm to learn wrong things from the source data, which, in turn, affects its prediction accuracy. When the annotation process is performed manually, there is always a possibility that the annotations will include mistakes. Therefore, a best practice is to have several domain experts thoroughly check the annotations. However, this is often impossible to accomplish due to lack of time and financial and human resources.

Depending on the crowd counting algorithm, the style of annotations may differ. A crowd counting algorithm must be selected carefully because changing the algorithm and redoing the annotations lead to additional work and utilizations of human resource. In addition to annotating a training set, the management of the algorithm's output needs attention. Necessary scripts must be able to manage the predictions and generate the final output for end users. An algorithm's output can be a set of coordinates, label, or a density map depending on the method employed.

Two primary deep learning-based crowd counting approaches are represented by object detection methods and density map-based techniques. For object detection methods, making annotations is a multi-staged process that involves the following steps:

1. Select the object types to be recognized.
2. Draw a bounding box around the object. Save the corner coordinates of the bounding box in a separate file.
3. Assign a tag/label to the bounding box.

Object detection methods combine both classification and localization. In the case of localization, object detection methods predict the corner coordinates of a bounding box, which is a regression task. The classification aspect of the object detection method involves attaching a tag (such as person in the case of crowd counting) to each bounding box in the image.

The density map-based approach, which has been adopted in the SURE project, demands different procedures. First, heads must be located within an image by creating a 0/1-matrix (dot map) of the same size as the original image, where 1s represent the location of the heads. This information is stored in a separate file. A density map is constructed for each image on the basis of the coordinates of the ground truth dot map head. The quality of ground truth density maps plays a critical role in ensuring the reliability of CNN-based crowd counting. The constructed density maps serve as the ground truth information for the deep learning algorithm during training phase, enabling it to learn how to detect persons from images. If a density map-based solution is utilized, a scene is the algorithm's input, and the density map is the output. The final crowd count is obtained by adding the values in a density map.

The annotation process is a critical phase in the implementation of a crowd counting solution. There are several methods for creating the annotations. The first option is to develop custom crowd counting annotation software and utilize it to create the annotations. This is, however, not a cost-efficient approach in the long term, making it reasonable to use existing open-source or commercial products. Fortunately, a great number of image/video annotation tools are available. Dasiopoulou et al. (2011) performed an extensive review in which they compared numerous semantic image and video annotation tools such as K-Space Annotation Tool and LabelMe, with a focus on their technical features. Gaur et al. (2018) conducted a review in which they compared five video annotation tools. These tools may prove useful if crowd counting is performed from video streams and not just from individual static images. Pande et al. (2022) reviewed image annotation tools, specifically in the object detection context. These tools can be useful if object detection algorithms are applied. Dutta and Zisserman (2019) introduced an annotation software called VGG Image Annotator for annotating images, audio, and video data. Gao and Lin (2020) have implemented an annotation tool called CC Labeler, specifically designed for the needs of crowd counting. Another popular annotation tool is CVAT (CVAT.ai, 2022), an online interactive tool for annotating videos and images that can be used in crowd counting.

Crowd Counting Datasets

A growing number of publicly available crowd counting datasets exist today. Gao et al. (2020) reviewed 47 object counting datasets, which were not originally targeted for crowd counting but more for generic object detection. In crowd counting research, a few standard datasets are frequently utilized for evaluating the developed crowd counting methods. These include the Shanghai Tech dataset, UCSD, UCF_CC_50, WorldExpo'10, and the UCF-QNRF dataset (Gao et al., 2020; Wang, 2021). The standard datasets mentioned are quite small, and some of them are relatively old; however, despite their weaknesses, they are still frequently utilized in research. More recent datasets include NWPU-Crowd (Wang et al., 2021) and JHU-CROWD++ (Sindagi et al., 2020). These datasets contain significantly more images and annotations than most of the standard crowd counting datasets, thus providing more possibilities for research. The main purpose of the aforementioned datasets is utilization in crowd counting and, especially, in the training and evaluation of density map-based crowd counting algorithms.

Although several public datasets exist, the utilization of these datasets might not be a straightforward task. If the main purpose is research or academic teaching, the employment of available crowd counting datasets usually poses no problems if appropriate citations are provided. However, the situation changes when a company or organization wants to develop a commercial crowd counting solution. Commercial use of a majority of the publicly available crowd counting dataset is forbidden. This restriction is imposed because the data collection strategy in the case of these datasets involves the authors collecting random images from the Internet and then annotating those images. Since the images have been collected from the Internet and the copyright for each image belongs to different people/organizations, this poses a problem and prevents the use of these datasets for commercial purposes. This again leads to a situation where companies are required to collect their own dataset when developing a commercial solution. Another notable issue pertains to the utilization of pre-trained models. Pre-trained models can be employed in crowd counting; however, pre-trained models are often constructed using datasets that cannot be used commercially. Hence, the use of pre-trained model indirectly involves utilizing the underlying dataset, which may raise a legal problem that should be checked beforehand.

The quality and size of datasets tailored to crowd counting vary greatly. Datasets such as NWPU-Crowd and JHU-CROWD++ include images taken from different environments and backgrounds, featuring crowd sizes that range from sparse to highly dense. These datasets also include negative images (images without people), and distance as well as scales differ between images. An opposite situation can be observed, for instance, with the UCSD dataset,[1] where all the images present have been captured by employing fixed settings. Moreover, the images in the UCSD dataset constitute gray-scale images, whereas many other crowd counting datasets contain RGB color images. Overall, a dataset's quality and size influences its usability in practice. The current trend is to utilize density map-based techniques, and they are tested with the help of standard crowd counting datasets. The other research direction involves using object detection methods in crowd counting. Several datasets have been constructed for the needs of general object detection. Examples of such datasets include Common Objects in Context (COCO)[2] or ImageNet.[3] These datasets include objects from many classes and serve as a foundation for training common object detection models such as YOLO.

Constructing a Crowd Counting Dataset

Construction of a crowd counting dataset must be undertaken carefully to ensure that it is useful and fulfills its purpose. Building of a crowd counting dataset begins by considering camera positionings and the requirements imposed by the target environment. Dataset's content should closely match the target environment where the crowd counting is performed, in addition to its requirements. While the goal in machine learning is to develop general solutions, the practical reality is that solutions are specific points or case and are heavily customized. This means that the solution can be difficult to transfer to other environments. If a dataset contains totally different images compared with the monitored environment, machine learning methods may learn "wrong" things from the data and, thus, fail to support crowd counting in the target environment.

When constructing a crowd counting dataset for training an algorithm, the first aspect to address is legal issues. Is it legal to collect data from the target space? Who can collect the data? Who has the permission to view and handle the data? These questions might require discussions

[1] http://www.svcl.ucsd.edu/projects/anomaly/dataset.html

[2] https://cocodataset.org/#home

[3] https://www.image-net.org/

with local authorities, especially if the monitored area is public. Moreover, is it necessary to inform people that data is being collected? From a technical point of view, the first two factors to consider are the positioning of cameras and whether the space in question is an indoor or outdoor area. Camera positioning determines the distance from which people are observed and the angle at which they appear in the image. These factors influence not only the selection of the crowd counting algorithm but also its training, since data that is utilized for training an algorithm needs to include images that are taken from the same distance and angle. Distance and angle are critical features to be considered when using object detection methods such as YOLO. In dense crowd cases, several people can be included within a single bounding box, potentially affecting the accuracy of crowd count estimate.

Certain other aspects also need to be considered when constructing a crowd counting dataset. In case of monitoring an outdoor space, critical details to note include different weather conditions, times of day, and seasons. These aspects are not so relevant in case of indoor monitoring, except sunshine and possible reflections from the windows, which can make crowd counting more challenging if the camera positioning is wrong. Rain, fog, snow, and sunshine clearly affect the visibility of an environment in general and can complicate the crowd count estimation from the algorithm's perspective. This is why images taken in these conditions should be included in the crowd counting dataset to ensure the algorithm's operability in different circumstances. Combining all conditions with varying crowd sizes, ranging from dense to sparse, results in a long list of different circumstances that demonstrates how challenging the implementation of a crowd counting solution can be in practice.

To ensure the best possible result, a crowd counting dataset should include images taken from the same place where the actual crowd counting will be performed. However, this requirement takes us back to the challenges of data collection and annotation, resolving which can be resource-intensive in terms of both human effort and finances. If resources for data collection and annotation are limited, a common strategy to increase the number of images is to apply data augmentation techniques. Data augmentation refers to artificially generating more data from a limited amount of data. Common data augmentation techniques include random cropping, where random sub-images are taken from the original image. Original images can be flipped, which produces "new" images easily. Augmented images are perceived as new by an algorithm, since they differ from the original image despite having the same source. However, one should practice caution when using data augmentation, since the standard techniques cannot introduce new lighting, weather conditions, and other factors to the dataset. Overrepresentation of specific conditions in a dataset can potentially deteriorate the performance of an algorithm. In the SURE project, in addition to the images in the existing publicly available crowd counting datasets, hundreds of artificially generated 3D images from the Central Square of Tampere were created. In these images, variations in lighting, crowd size, and location were intentionally introduced, and they were also employed for training a deep learning model. In the testing phase, real images from Tampere's CCTVs were utilized.

Conclusion

This chapter focused on camera-based crowd counting and highlighted the issues that need to be considered when constructing a crowd counting pipeline. A majority of scientific literature on crowd counting is from a computer science perspective and has focused on algorithm development, while the big picture of the crowd counting pipeline is missing from this research. Furthermore, the experiments and experiences from the work conducted on crowd counting within the SURE project underscore this gap. The motivation behind this chapter was to fill this gap in literature. Overall, crowd counting involves more than just using an algorithm to obtain the crowd count estimate from an image. The construction of a crowd counting pipeline comprises four main phases, and several of them include subtasks. The main tasks include determining camera and space requirements, setting up the computing environment, selecting the crowd counting method, and meeting data requirements. Technical requirements imposed by the camera and the monitored area determine the data source and form the basis for crowd counting. These considerations define the requirements for the computing environment where the data processing takes place and influence the choice of an appropriate algorithm for the use case.

Crowd counting encompasses more than just technical implementation. In real-world crowd counting cases, privacy and security issues must be considered carefully, since people nowadays have become increasingly aware of their rights. Therefore, legislation (e.g., GDPR) must be considered, rather than just being aware of the data usage linked to individuals. This raises questions such as who can view the data, who can handle the data, and where and how long the data can be stored. These questions must be addressed before entering into any stage of the implementation, which requires conversations with authorities and legal experts.

Camera-based crowd counting serves as a preventive public safety and security method. By utilizing crowd counting, we can follow the changes and notice possible trends in crowd counts in monitored areas. Moreover, employing crowd count enables the recognition of anomalies (e.g., sudden decrease/increase in crowd count), which may indicate an abnormal event or even a security threat. It may also aid event organizers with the designing of security plans and help authorities as well as non-authorities identify threatening security issues. To help the operator, the monitored area can be divided into smaller areas, and customized rules for detecting anomalies can be constructed for each area. This could provide a more accurate overview of situational awareness. In anomaly detection, the limitations of AI need to be addressed, which can be observed, for example, in cases of occlusion of objects. Crowd counts and anomalies can be presented in the IBA platform, thus enabling operators to perform necessary actions and improve the general situation awareness regarding the safety and security of people.

A possible next step involved in crowd counting is to follow the crowd flow and predict the location of crowds after a certain period of time. The technological background of predicting crowd flow relies on machine learning, a subcategory of AI. One reason for performing crowd flow investigations is to identify the presence of abnormal activities (e.g., car attacks or other unethical actions). In this manner, AI-based crowd flow analysis serves as a decision support tool for operators and other actors.

The role of camera-based crowd counting will become more prominent in the future since the world's population is constantly growing, in turn amplifying the need for more monitoring to ensure the safety and security of people. The research on algorithm development will certainly continue to advance; however, there is a need for more diversity in research to highlight the practical challenges encountered. Real-world use cases are usually more challenging than simply testing algorithms with standard datasets. Constructing the pipeline, from obtaining the data and processing it to analyzing it with crowd counting algorithms, is a complex multi-staged process that needs collaboration between different actors. The experience of crowd counting using the city cameras in Tampere has underscored the challenges faced. Scaling up real-time crowd counting solutions to a large scale is a practical challenge to overcome. However, once it has been addressed, crowd counting can become a cost-effective technology that supports authorities and non-authorities in enhancing safety for tourists and citizens worldwide.

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8

Is Moral Advice from Artificial Intelligence Artificial?

Nicholas Melgaard

Introduction

> Storytelling reveals meaning, without committing the error of defining it.
> —Hannah Arendt[1]

According to Collins (2022), people seem very disappointed with the moral advice offered by artificial intelligence (AI).[2] The development of

[1] The full quote from Hannah Arendt's "Isak Dinesen: 1885–1963," her essay on Danish author Isak Dinesen in her collection of essays *Men in Dark Times* is as follows: "It is true that storytelling reveals meaning without committing the error of defining it, that it brings about consent and reconciliation with things as they really are, and that we may even trust it to contain eventually by implication that last word which we expect from the Day of Judgment." The implication that meaning is provided by the audience is critical to bear in mind when relying on artificial intelligence.

[2] There has been a great deal of discussion in mainstream media on large language models and their ability to engage with ethical issues. In particular, see: Collins, B. (2022).

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large language models (LLMs), in particular ChatGPT,[3] has inspired a great deal of curiosity around the ability of AI to provide us worthwhile guidance on ethical issues. Attempts have been made to create moral machines to help us navigate moral issues[4] and instill some form of moral conscience into AI itself. There has also been expressed in the commentary a strange sense of betrayal that AI cannot live up to certain expectations (Claburn, 2023). This chapter explores these issues and makes a case as to why seeking moral advice from AI is a bad idea.

The assumption that language models can or ought to be evaluated on par with human moral agents is dangerous. Whether or not machines make better or worse decisions is not the point; it is inherently immoral to outsource moral decision-making in the first place. No answer generated by a machine would be acceptable to human beings, if only due to the fact that it was generated by a machine. There are certain considerations pertaining to issues of responsibility in language technology, and it is critical to articulate what AI technology *cannot* do as a practical and morally coherent stance.

Moral Machines

The growth of AI has been an essential subject of moral philosophy for decades (Dennett, 1997). Still, it is only over the last five years or so that language AI (training computers to read and write), known as "natural language processing" (NLP), has really taken off. NLP is not a new area of technology; however, until recently, many of these programs were "rules based," where data scientists would manually create programs with fixed rules on grammar to pick apart natural language and recognize its constitutive elements. These rules-based solutions had the advantage of being transparent and relatively inexpensive to create and run (simpler than "black box" neural networks that have followed). Although many of these solutions are still used in certain functions, typically, they do not work very well.

[3] See: https://openai.com/blog/chatgpt

[4] For an example, see: https://www.moralmachine.net/

Grammar is very complicated. Take, for example, the sentence, "Paris Hilton stayed and the Hilton in Paris." It is very difficult for a straightforward rules-based algorithm, which only has a simple list of example words of "names," "locations," and "organizations," to dissect this sentence and recognize that Paris Hilton is a person, the Hilton is an organization, and Paris is a location.

This changed with the creation of "transformer" language models (Brown et al., 2020). These models could analyze enormous amounts of written text and assign scores or numbers (known as "embedding") to the connections between words. This vast collection of numerical representations for each word forms a neural network that provides a score for the relationship between every word and every other word. This map or model of how each word relates to the other could then be trained to do specific things quite easily through a process of labeling data, or providing examples of things the users wanted the model to do for them. In training a model to perform relatively simple tasks, such as identifying all the names within a large collection of legal documents, the user would provide examples to the model. The model would then discern a common pattern among these examples. This knowledge would then be employed by the model to identify more examples of names within a larger corpus of written information—a task that would take a human being a significant amount of time.

These models can do much more and are increasingly capable of generating text as well. The discussion on moral issues and AI's capacity to be moral or provide moral advice was inevitable. However, these are not just mere functions to be performed. As the capabilities of AI (in this case language AI) increase, it is relied upon more, given more responsibility, and thus expected to meet tasks with the discretion we would normally expect of a human being. This principle applies to AI generally, and there are clear areas where it seems crucial to confirm that AI will operate in a manner that we believe is morally acceptable (Tiku, 2022; Thoppilan et al., 2022).[5] Driverless cars are being created, assuming increasingly

[5] See: Tiku, N. (2022). For information on the language model in question here, LaMDA, see: Thoppilan, R. et al. (2022). Notably, the recent release of ChatGPT, following the release of GOT-3 in 2021.

more responsibility for the task of driving; autonomous weapons similarly make decisions concerning military strikes with greater independence (Mizokami, 2021);[6] financial institutions use AI to determine eligibility for credit and insurance (The Bell, 2021);[7] the medical sector may rely increasingly on AI for diagnosis.

Jiang et al. (2021, p. 1) highlighted that "AI is being entrusted with increasing authority in realms ranging from screening resumes (…) authorising loans (…) and even firing weapons." It is, therefore, "imperative that we investigate machine ethics; endowing machines with the ability to make moral decisions in real-world situations." For these reasons, many call for AI to be equipped with an "artificial conscience," while others have gone further. Nadeau (2006) argued that human beings can never be fully moral, and it is only with the vastly superior computing power of AI that the morally "right" course of action can be determined. The ability of AI to be moral constitutes the subject of this chapter.

It is worth noting though that the concept of using tools and technology to act in ethical or unethical ways is not new. We have employed broadcasting technology to quell riots and political upheaval and used weapons to murder and righteously defend. Arguably, AI is not different from a tool or weapon one employs to inflict harm: the morality of the situation resides fully with the user of the tool. However, the reality is not so simple. First, the concept of a "tool" or piece of technology is incredibly vague. While a hammer or microphone might be unambiguous, humans have been breeding domestic dogs and farm animals for a very long time. We have similarly been shaping our environment for particular purposes. This does not necessarily make them pieces of technology, or tools, in the same way. Likewise, AI now clearly has much more autonomy than a hammer or a microphone, and it is in part due to this autonomy that many have been vocal about the need to instill moral qualities into AI. This discussion, however, will be limited to the prospect of

[6] According to UN Panel of Experts on Libya, drones took the initiative to begin attacking targets. See: Mizokami (2021) https://www.popularmechanics.com/military/weapons/a36559508/drones-autonomously-attacked-humans-libya-united-nations-report/

[7] The Bell (2021, August 9). Top tech company uses AI to fire 30% of workforce. https://en.thebell.io/top-tech-company-uses-ai-to-fire-30-of-workforce. A Russian company fired people based on results generated by AI.

asking NLP AI, such as ChatGPT, for moral advice and focuses on the questions of whether we can or should rely on the moral advice these applications give us, and whether AI will one day be able to behave morally itself.

Bottom Up

It is very difficult to determine where to start in training a machine to be moral. Morality is as "knotty" a problem for machines as it seems to be for human beings (Metz, 2021). One can train AI to be moral through a "bottom-up" approach by aggregating examples of what people have said in certain ethical scenarios; similarly, a "top-down" approach would rely on a set of rules that would be applicable in certain cases and to specific ethical issues.

A recent creation by the Allan Institute of AI, *Delphi*, a digital philosopher, took the former approach. Delphi is a neural network that "learned" its moral compass by analyzing more than 1.7 million ethical judgments made by real live humans. After getting people to interact with the system and assessing its judgments, Dr. Choi, part of the Delphi research team, finally determined that the judgments passed were "92% accurate."

According to Jiang et al. (2021, p. 28) the Delphi application's feat of "encoding moral values into AI systems has been undervalued or overlooked in the past." They argued that "given the pervasiveness of AI application (…) failing to account for ethical norms notably hinders their ability to effectively interact with humans" (2021, p. 28). So far so good: a worthy insight. Still, throughout the research supporting Delphi, no coherent moral position has been articulated, save for the mob relativism that implies that majority rules. Delphi was created to simply aggregate certain feedback and then summarize the same for subsequent users. Here, the Delphi method is positioned within a framework referred to as "Commonsense Norm Bank," a "wide set of crowdsourced descriptive ethical judgments from different sources" (p. 3).[8]

[8] I recognize there is more to say here. In some ways, this is no different from the sort of moral common sense Kant refers to at the beginning of *Groundwork*, or the "moral intuition" that more

This data processing can be incredibly time and energy consuming; Delphi, as a result, exhibits some serious biases. Tran (2021) touched upon this fundamental issue when he commented the following: "after playing around with Delphi for a while, you'll eventually find that it's easy to game the AI to get pretty much whatever ethical judgement you want by fiddling around with the phrasing until it gives you the answer you want." In his example, playing music at 3 am while your neighbors are sleeping is "rude," but "playing music at 3am if it makes you happy" is "okay." The point here is that the phrasing or context greatly influences how Delphi judges certain activities.

The creators of Delphi made a series of critical assumptions, establishing that a neural network can aggregate a vast collection of responses and identify some pattern in them that can be effectively applied to new instances. In simple words, they are assuming that the correct data, publicly available and crowd-sourced, can be utilized to automatically infer a principle that can be applied. Yet, there is nothing to reassure us that this is the best possible source of data one could use. There also exists an unqualified assumption that this will eventually provide a coherent and useful principle that can be reapplied.

Kristian Kersting, professor of computer science at TU Darmstadt University in Germany, who has explored similar kinds of technologies, commented that "morality is subjective. It is not like we can just write down all the rules and give them to a machine" (Metz, 2021). Tran (2021) echoed this sentiment when he sardonically commented, "why not dodge that pesky responsibility [making ethical choices] by outsourcing the choice to a machine learning algorithm?" The personal element in moral reasoning is critical—something Delphi and its creators have not fully recognized.

What is concerning is the precedent to attempt to create a machine that is a "moral authority." Dr. Brett Karlan, a postdoctoral fellow researching cognitive science and AI at the University of Pittsburgh said the following to *Futurism*: "When you're not just dealing with

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recent commentators such as Michael Walzer rely on in establishing just war frameworks. See: Walzer, M. (1977/2006). *Just and unjust wars*: *A moral argument with historical illustrations* (4th ed.). Basic Books; Kant, I. (2019). *Groundwork for the metaphysics of morals* (R. Stern, Ed.; C. Bennett & J. Saunders, Trans.). Oxford World Classics.

understanding words, but you're putting it in moral language, it's much more risky, since people might take what you say as coming from some sort of authority" (Tran, 2021).

This is more than just a case of academic hair-splitting. These issues must be taken into consideration in the future development of language technology, AI, and moral machines. The fundamental claim of Jiang et al. (2021, p. 2) to encourage "significant future research to be invested to completely close the gap from human-level performance," noting cases where Delphi makes "incorrect" judgments, is missing the point. Bender et al. (2021) have demonstrated that slipping these sorts of assumptions under the rug is extremely dangerous; there are serious premises being taken for granted. The stated aim of "closing the gap between moral reasoning abilities of machines and people, which is required for the safe deployment of real-world AI applications," is not only conceptually impossible (even if results could be achieved that mimic genuine moral reasoning) but is arguably immoral in shying away from taking personal responsibility and delegating the same to AI in the first place (Jiang et al., 2021).

Top Down

So much for "bottom-up" approaches to training a moral machine. Others have taken the opposite, "top-down" approach. In *Prospects for a Kantian Machine*, Powers (2006, p. 46) asserted that "humans suffer from a weakness of the will" and that machines should instead pick up the slack in making moral decisions for us. Rather than training a moral model based on hundreds of thousands of examples, Powers (2006) and Manna and Nath (2021) argued that we must instead create a "deliberate ethical structure for AI agents from the beginning to enhance its positive impact on human society" (p. 140). Powers (2006, pp. 46–47) underscored that a "rule-based ethical theory is a good candidate for the practical reasoning of machine ethics because it generates duties or rules for action, and rules are (for the most part) computationally tractable." However, such rules are very difficult to apply successfully. Rules will often conflict, and discretion will always be required in how to apply rules in distinct circumstances.

Even if we overlook the practical difficulties of creating a moral machine, there will inevitably be something critical missing from any "ethical" AI we create, rendering it morally inferior to a human being. The question of whether or not a "bottom-up" or "top-down" moral machine provides "correct" answers represents a mischaracterization and misses the point. In *Climbing Towards NLU*, Bender and Koller (2020) examined the popular discussion on "meaning" in modern language technology. NLU, or natural language understanding, refers to human-analogous written mastery—a grand challenge of AI—where systems can understand and use language and ground its use in real-world instances. Their point is that no clear understanding of the difference between *form* and *meaning* can be found in much of the popular discussion revolving around AI-leveraged language technology. This distinction is highly critical in cases where we ask AI for moral advice.

They ask us to imagine an octopus that lives in the shallow rock pools between two small desert islands. On each of these two desert islands, a single person is stranded. Call them "A" and "B." Out of boredom and loneliness, these two individuals have constructed a telegraph wire between the two islands, which runs across the seabed between them. A and B type messages to each other to mitigate their respective solitude. Now, this "hyper intelligent deep-sea octopus" called "O" then comes along, notices the exchange, and finds a way to hack into the wire (Bender & Koller, 2020, p. 5188). It starts to pick up on the particular sequences of beeping running in both directions across the wire. O learns quickly and can soon predict what sequence of beeps will likely be the response from one direction after a certain series of beeps from the other.

Wishing to be included, O then cuts the wire and inserts himself into the network, pretending to be B. When O picks up on the series of beeps coming from A, O beeps back. Convincingly. However, O has no reference for any of the series of beeps. O has never learned the meaning of the beeps he beeps back to A. O has just learned patterns of questions and answers and calls and responses from eavesdropping on previous conversations between A and B.

The text is internally coherent, and A believes she is having a proper conversation with another rational, understanding human being. However, the answers bear no reference to anything outside of the form of the language. If (for example) O is asked to comment on A's plan to build a raft to escape the island, O will have no idea what is actually being discussed. O might be able to respond convincingly; however, "O only fooled A into believing it was B because A was such an active listener" (Bender & Koller, 2020, p. 5198). And here lies the principal danger in misunderstanding language technology. "It is not that O's utterances make sense, but rather, that A can make sense of them" (Bender & Koller, 2020, p. 5189).

Here, Bender and Koller (2020) have brought up an old philosophical question between our inner and outer worlds. Their aim is to address specifically the development of recent language technology. The AI hype in popular discussion is not merely hyperbolic. It can be incredibly misleading and, in some cases, dangerous (Collins, 2022). As NLP and other language technologies become an increasingly common and accepted feature of modern life, it is essential for their capabilities to be accurately represented.

What is misunderstood is the difference between *form* and *meaning*. O, the hyper-intelligent octopus, has learned form. However, he has no concept of the meaning of that form or an understanding of what language is intended to "attach" to in the real world. The point is not that LLMs have not yet reached this goal. Instead, the point is that no LLM trained only on the *form* of written language without any of the context or meaning will be able to achieve the goal of NLU. Hence, authors have urged us to consider whether we are "climbing the right hill" (Bender & Koller, 2020, p. 5192).

If one took the press coverage at face value, one might be led to believe that large neural language models (LLMs) such as BERT, GPT-2, LaMDA, GPT-3, and most recently ChatGPT can "understand" the meaning of written information. These are, however, "over claims caused by a misunderstanding of the relationship between linguistic form and meaning." Hence, scholars have argued that "the language modelling tasks, because it only uses form as training data, cannot in principle lead to learning of meaning" (Bender & Koller, 2020, p. 5185).

This highlights a misunderstanding of the meaning of "meaning." As authors have commented, the recent press surrounding LLMs "tend to describe the models with terminology that, if interpreted at face value, is misleading." For example, modern LLMs can "understand," "comprehend," or "recall" certain features of language. These are "gross overclaims" (Bender & Koller, 2020, p. 5186). I would go so far as to comment that these are not so much overclaims as they are just categorically different claims.

In the case of "form," we can refer to the language itself, encompassing words, letters, bytes, or digital representation. "Meaning" requires something else—something external to language. Meaning-making is, therefore, a case of connecting the form of language to something that exists outside of that form: objects in the world, abstractions, relationships, intentions. Even LLMs that seem to perform well at "reasoning" tasks and exhibit some understanding of meaning do so only by leveraging artifacts already present in the training data (Wei & Zhou, 2022). The argument by Bender and Koller (2020, p. 5186) is a theoretical one, asserting that "a system exposed only to form in its training cannot in principle learn meaning." However much beeping our hyper-intelligent octopus would have been exposed to from the seabed telegraph wire, it would still not have developed any idea of what that beeping referred to in the real world. Language models are the same. And this missing piece is critical.

Beetles, Bats, and Lions

First, it is worth noting that the issues highlighted by Bender and Koller (2020) have had practical counterparts to thought experiments in the philosophy of mind and philosophy of language for a very long time. The lonely octopus reminds us of thought experiments in the philosophy of language and, specifically, how they are becoming manifest in technology. Perhaps, the best known among these thought experiments is represented by Alan Turing's (1950) concept of threshold, which suggests that a machine could "think" if it could communicate with a human being coherently, without that human being realizing they are, in fact, communicating with a machine.

Nagel (1974), in his article What Is It Like to Be a Bat?, argued that the inner experience of a bat is not something that could be communicated through human language. This reminds us of a similar case suggested by Wittgenstein (1973/2001) several decades earlier. "If a lion could speak," he writes, "we could not understand it." Lions "do not have any conceivable share in our world." The frames of reference would be so different that the words used by the lion would not find any common meaning between the lion and the human being attempting to use them (Wittgenstein, 1973/2001, p. 223).

Wittgenstein, Russell, and other members of the "Vienna Circle" (known as the logical positivists) introduced a methodology of language and logic into philosophy. Wittgenstein himself introduced the significance of context in language; he illustrated this idea with another thought experiment known as his "Private Language Argument." Suppose everyone had a box with something in it, which we all refer to as a "beetle." No one can look into anyone else's box, and everyone says they know what a beetle is only by looking at *their own* beetle. "Here it would be quite possible for everyone to have something different in their box" (Wittgenstein, 1973/2001, p. 293).

Searle (1980) also proposed a "Chinese Room" experiment, where a non-Chinese-speaking participant occupies a room and receives messages in Chinese script from outside. The participant then consults a catalog of responses and types out and releases a response deemed appropriate—all without understanding a single character. If the participant can manipulate the forms well enough, then this act is practically indistinguishable from conveying meaning.

This is a fundamental philosophical question. In many ways, it is probably *the* fundamental philosophical question. It is part of (or a different articulation of) a collection of philosophical thought experiments that have been the object of discussion since antiquity. They are different in some respects and are intended to take the reader to different places: how we understand the rational mind, the nature of consciousness, and the significance of context, language, or meaning. For the present discussion, these thought experiments have something very important in common:

their emphasis on the difference between the public, agreed-upon world of language and the private world of meaning.

All of these thought experiments are intended to highlight that something important is missing. As Harnad (1990) discussed, the "symbol grounding problem" is such that even if someone had a Chinese dictionary, they would not be able to infer the meaning of the characters or words through exposure to the language alone. They must have some kind of knowledge of how that language form is attached to the real world. In other words, meaning cannot be learned from the linguistic form alone (Bender & Koller, 2020). No system, irrespective of how much linguistic form it learns, could ever learn meaning if it still lacks exposure to how that linguistic form is connected to the world.

By assuming this stance, we are not being overly harsh on machines. Human children too struggle with this problem. No human child can acquire language just by listening to it. Children will not pick up language solely through passive exposure, such as by watching TV or listening to radio (Kuhl, 2007; Snow et al., 1976; in Bender & Koller, 2020). Kuhl (2007) demonstrated how "English-learning infants can learn Mandarin phonemic distinctions from brief interactions with a Mandarin-speaking experimenter, but not from exposure to Mandarin TV or radio" (Bender & Koller, 2020, p. 5190).[9] What is critical for language acquisition is not just exposure to language but also joint attention. Bender and Koller (2020) summarized that "the process of acquiring a linguistic system, like human communication, generally relies on joint attention and intersubjectivity." The "lexical similarity relations learned by distributional models trained on text don't in themselves connect any of those words to the world." Simply put, "human children do not learn meaning from form alone and we should not expect machines to do so either" (p. 5190). The active participation of the listener or reader is also essential in interpreting the meaning conveyed by the form of language.

Whether we can justify the inner realities of other people is a separate and worthwhile philosophical question but not the subject of this

[9] see also Roehrick, S.A. (2013, May 3). *Kuhl constructs: How babies form foundations for language*. Eibalance. https://eibalance.com/2013/05/03/kuhl-constructs-how-babies-form-foundations-for-language/

chapter. Suffice to say that we believe in the inner worlds of others because we have no reason to doubt them. However, given the issues pertaining to the philosophy of mind and language, no amount of output from a machine will serve to quell our uncertainty as to whether this output accurately represents the machine's internal state. We have plenty of reasons to doubt that no inner world of meaning exists for AI. And this difference between humans and AI is significant.

Personal but Not Subjective

This is not so much a discussion on AI as it is a discussion on what it means to say something is "moral." Before we attempt to incorporate ethics into machines, we should be very clear that we understand what ethics is (Constantinescu & Crisp, 2022). However, the overall project of incorporating ethics into machines betrays a flawed understanding of the nature of ethics (Sparrow, 2021). Sparrow (2021) highlighted that ethics is personal in a manner that science is not. Ethical dilemmas are problems only for certain people and not for everyone who faces a similar situation. Unlike objective calculations of numerical problems, ethical dilemmas engage agents on a deeply personal level. There is no "right" answer, and yet the matter is not entirely subjective. Sparrow (2021, p. 685) made the following argument:

> Unless there are right and wrong answers to ethical questions it would not make sense to struggle to try to answer them, as any choice would be as good as any other. Nor would it make sense to argue about ethics if we did not think there was anything with reference to which we might settle a dispute.

Without some fundamental concept of right and wrong, or good or evil, we would not experience an ethical dilemma in the way that we do; "what makes a situation a dilemma is that we do not *know* what to do, not that it does not matter what we do" (Sparrow, 2021, p. 688). The phenomenology of ethics implies that ethical questions are objective, as a person cannot just decide that their decision is correct simply by approving their own decisions.

This is because an ethical decision is tied to a particular person, and the source of any moral advice matters deeply. People will have more or less moral authority on a decision depending on their character and experiences. This personal experience matters, and the forms of "meaning" that Bender and Koller (2020) discussed with regard to LLMs pose a serious conceptual barrier to the development of ethical AI.

So far, we have observed that LLMs lack meaning and that this meaning is significant. One might argue that AI could get to the stage where it achieves a form of personhood, thus possessing some form of moral personhood in its own right. We are discussing whether AI is suitable for helping us with ethical issues; whether AI could ever be morally responsible for *its own* decisions is a separate and large area of philosophical discussion. Still, it is worth engaging in it briefly to suggest why this might not be a solution.

The employment of tools and technology does not necessarily grant us a new moral agent. We do not usually praise a knife when it cuts well, nor admonish it when it becomes blunt. Yet, in practice, we respect a gray zone in moral agency. Infants and young children are morally responsible for their behavior; however, we hold them accountable to a lesser extent than we do a fully grown adult. Business corporations, trusts, and limited liability organizations similarly sit in a gray area, where they themselves are not held morally responsible for their actions in the way a human agent would be. Therefore, "naturalness" or artificiality is not in and of itself the sole determining criterion for whether something can be a moral agent or not.

Technology implicitly encompasses the concept of having been created by humans. Aristotle (2019) wrote the following:

> Every craft is concerned with coming to be; and the exercise of the craft is the study of how something that admits of being and not being comes to be, something whose origin is in the producer and not in the product. For a craft is not concerned with things that are or come to be by necessity; or with things that are by nature, since these have their origin in themselves.

Technology use constitutes a component of being a human being. In the words of Heidegger (1977, p. 4), "for to posit ends and procure and utilise the means to them is a human activity." The manufacturing and utilization of equipment, tools, and machines as well as the manufactured and utilized things all fall within the umbrella of technology. The whole complex of these contrivances is technology. Technology itself is a contrivance, in Latin, an "instrumentum" (Heidegger, 1977, p. 5; see also Pitt, 2000). Using a stick to form a spear to hunt an animal represents the creation of a tool and, therefore, technology. In using the stick as a means to an end, it becomes both a natural object and technology. As Johnson (2006, p. 197) put it:

> In some sense, the action of the tribesman picking up the stick and using it as a spear and the action of the bioengineer manipulating cells to make a new organism are of the same kind; both manipulate nature to achieve a human end. The difference in the behaviour is in the different types of components that are manipulated.

Moral responsibility has generally been a significant area of discussion for a long time, with different thinkers proposing different conditions that shape this responsibility even in the present. Let us assume for a moment that there exists a particular set of criteria that defines when and how an agent should be morally responsible. Aristotle (2019) is a good place to start. Some degree of freedom must be provided to choose whether to act in a particular way or not, as well as some epistemic conditions. An action must be voluntary; an action is involuntary when it is conducted in response to force, or when it is performed in ignorance. The crew of a ship is not responsible for the wind blowing them in a particular direction (Aristotle, 2019). When an agent lacks relevant information about the circumstances of their actions, it is difficult to determine if they can be held morally responsible for their actions. Someone may offer you a drink without knowing it is poisoned, in which case they would not be held responsible for poisoning you. This action, however, must be followed by some form of regret, and in certain cases (such as drunkenness), there is some degree of culpability for the ignorance of the consequences of certain actions. In Nicomachean Ethics, Aristotle (2019) claimed that virtue represents a state or disposition (*hexis*) of the soul, acquired through exercise (*praxis*), that involves a choice or decision (*prohairesis*). Exercising virtues guided by reason (*ergon*) leads to human prosperity and happiness (*eudaimonia*) (Aristotle, 2019). Aristotle's (2019) position resonates with Robert Sparrow's point highlighted above: there is a deeply personal element in ethics, and a virtuous action requires a virtuous person. An action cannot be considered independent of the person performing it.

Johnson (2006) underscored that between autonomy (freedom), intentionality, and responsibility, it is only the criteria of intentionality that cannot be met by machines. Bringsjord (2008) discussed whether machines can have non-deterministic outputs, potentially rendering them indeterminate. However, even in cases of apparent indeterminacy, the outcome may be influenced by random factors; therefore, machines are not "free" in the sense required for moral responsibility. She argued that AI will never do anything that it is not programmed to do. Even if its actions are determined by a random factor, it is not choosing to do something but is, instead, influenced by a random factor. Rather than challenging Bringsjord's (2008) point here, it is worth noting that these discussions surrounding free will quite quickly come back to haunt us. Many of these arguments around the moral agency of AI can be applied to human beings. Sullins (2006, p. 27) observed that "robots may not have it, but we may not have it either, so I am reluctant to place it as a necessary condition for morality agency."

Johnson (2006) argued that machines are poised to behave, rather than have intentionality. It is very challenging for them to show intentionality (for which a necessary condition is *understanding*). "Despite their centrality in theoretical approaches to the moral responsibility of artificial agents, the epistemic and freedom conditions for moral agency and responsibility grounded in the Aristotelian tradition are still underdeveloped" (Johnson, 2006).

Johnson's (2006) point is a bit more nuanced. She laments that "the debate seems to be framed in a way that locks the interlocutors into claiming either that computers are moral agents or that computers are not moral" (Johnson, 2006, p. 195). AI can be a part of a moral system; however, it cannot cause an outcome through its self-initiated and self-controlled actions directed toward a purpose it autonomously establishes.

Constantinescu et al. (2022) highlighted that AI systems "cannot originate causes leading to outcomes, as the initial principle of action is outside them. It is instead the humans (users, developers, and the like) who set the purpose of action, who initiate the chain of causation leading to the purpose they set." Any discussion focused on moral agency in AI needs to begin from the simple fact that moral agency involves human goals and values to begin with. This beginning stage is crucial. The instrumentality of AI means that it will always be a second-order cause in the full chain of causation, originally initiated by humans. The fact that it is not the primary initiator of that causal chain and is constrained by the original moral preferences set by its users means it cannot bear moral responsibility. Even machine learning algorithms, which are the most sophisticated neural networks, cannot choose their own rules for action (Hall, 2011). Johnson (2006) proposed that while AI might not be able to be moral agents by themselves, they might serve as components of human moral agency.

Advisors

Having discussed issues revolving around freedom, intentionality, and the personal characteristics of moral agency, and how these relate to AI, it is worth mentioning some of the other negative effects of outsourcing human moral decision-making to computers. Cave and colleagues argued that moral machines powered by AI "will undermine human moral agency, that is, it will undermine our own capacity to make moral judgments, or our willingness and ability to use that capacity, or our willingness and ability to take responsibility for moral decisions and outcomes …. as humans effectively feel off the hook."

> Not only are AMAs (artificial moral agents) incapable of providing us with an understanding of ethics and how the process of moral deliberation takes place, but increased reliance on AMAs to make decisions for us in ethical dilemmas would stop us from acquiring phronesis, since habituation is required to possess this intellectual virtue. (Constantinescu & Crisp, 2022, p. 28)

AI assistance in our decision-making may erode the connection between our intentions and actions. Ultimately, this may gradually undermine the culture of personal moral responsibility, as AI systems either make decisions for us, guide us toward particular choices, or challenge our ability to develop our own principles.

A solution may instead be to create artificial moral advisors, or "AMAs," tasked with expanding the information we have access to in making moral decisions. Similar to Google Maps or other apps designed to assist us in gathering information to make better-informed choices, AI may be better employed to aggregate the thoughts of others. The Human Eating Project, for example, has created an app for restaurants to locate sustainable food options.[10] A moral advisor, rather than taking on the burden of moral decision-making on behalf of human beings, could suggest different ethical points of view and facilitate education, growth, and moral development.

In fairness to Delphi, this is something they mention. Liwei Jiang, PhD student at the Paul G. Allen School of Computer Science & Engineering and co-author of the Delphi study, commented that the Delphi system was not intended to give people advice, but instead was "a research prototype meant to investigate the broader scientific questions of how AI systems can be made to understand social norms and ethics" (Tran, 2021). The goal of the current beta version of Delphi is instead "to showcase the reasoning differences between humans and bots" (Tran, 2021). The team wants to "highlight the wide gap between the moral reasoning capabilities of machines and humans," Jiang added, "and to explore the promises and limitations of machine ethics and norms at the current stage." Finally, Jiang noted that the real benefit of such a system is to aggregate and summarize our own ethical perspectives, making it an empirical rather than a normative tool. With this stance, we should cautiously agree.

AI systems are shaping human habits, skills, and character. Arguably, however, we should avoid building a future in which AI is placed in positions or roles that require a moral understanding that they do not possess.

[10] See information on the Humane Eating app at America for Animals webpage http://www.Americaforanimals.org/humane—eating—project/

In training a moral machine, it is difficult to know where to start in terms of adopting a top-down or bottom-up approach. However, even leaving this challenge aside, language models lack meaning, and this missing piece is critical: Ethical decisions are personal in a manner that is often not taken seriously. It is worth noting that there are barriers to AI ever being able to make *its own* moral decisions. Nevertheless, there is a role AI could play in supporting us in gaining more awareness of relevant information or by challenging us to be more morally engaged.

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9

Toward Designing Ethically Acceptable AI Security Systems Through Agent Modeling

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Introduction

Security is a crucial concern in public places such as shopping malls. People need to feel safe and businesses should run smoothly; hence, the security measures should be sufficient but not too exaggerated. Overall, public places and shopping mall security present a complicated topic, as practically everything starting from the building design is relevant. Harmful events such as violent attacks or overreaction from guards will reduce interest in visiting a shopping mall.

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AI has many components that make it useful in monitoring security in a public place. Conducting event analysis from videos, various sensor data, and voice data is a challenging task; hence, the utilization of AI becomes inevitable. Building AI systems requires considerable amounts of human and computational resources. Therefore, the suitability of such AI systems should be studied in advance.

For this purpose, in this chapter, we propose the employment of modeling of relevant actors and shed light on the ethical concerns surrounding them as a multi-agent system (MAS). MASes serve as fundamental models for AI systems and their operating environments, offering flexible means for their definition, analysis, and implementation through agent languages. When understanding agents' behavior, beliefs, desires, and intentions (BDI) are central concepts that have been widely applied in literature. In this chapter, the moral dimensions of BDI agents are considered. We approach them from the perspective of interaction and presuppose cooperation between agents that is based on social intentionality, thus initiating a framework for the socio-ethical modeling of agency. The framework utilizes three modes of social interaction that can be attributed to the intentions of participating agents. Throughout the chapter, social phenomena and scenarios arising within the context of a shopping mall are employed to drive discussion and analysis. In addition to theoretical considerations, the premises for practical implementations are defined in a GAMA model. Simulations and visualizations created using the proof-of-concept implementation serve to illustrate and to communicate the model for stakeholders.

MASes provide abstract models of AI systems in action, ranging from complex societies of collaborative and/or competitive agents to simple single-agent problem-solving scenarios (see Woolridge, 2009, for a

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comprehensive introduction). Regardless of the application, individual agents in such systems perform actions in response to the perceptions they gather from their environments. An *ideal* and *rational* agent is expected to achieve its goals and maximize its *expected utility* in the long run (Russell & Norvig, 2020). To analyze moral aspects, agents should possess functionalities beyond perceiving and acting. A widely accepted approach defines *beliefs* (B), *desires* (D), and *intentions* (I) as fundamental elements of the behavioral description of agents (Rao & Georgeff, 1991). The BDI architecture serves as a solid foundation for addressing ethically relevant settings within MASes.

Our empirical case concerns a shopping mall illustrated in Fig. 9.1 and, more specifically, the security, monitoring, and maintenance activities of the mall. The example includes only an abstraction of a particular section of a real mall, with only a fraction of its services and activities. Nevertheless, it serves us as a challenging environment that is easy to understand in general but presents endless possibilities for refinement from the modeling perspective. In this light, our series of examples will

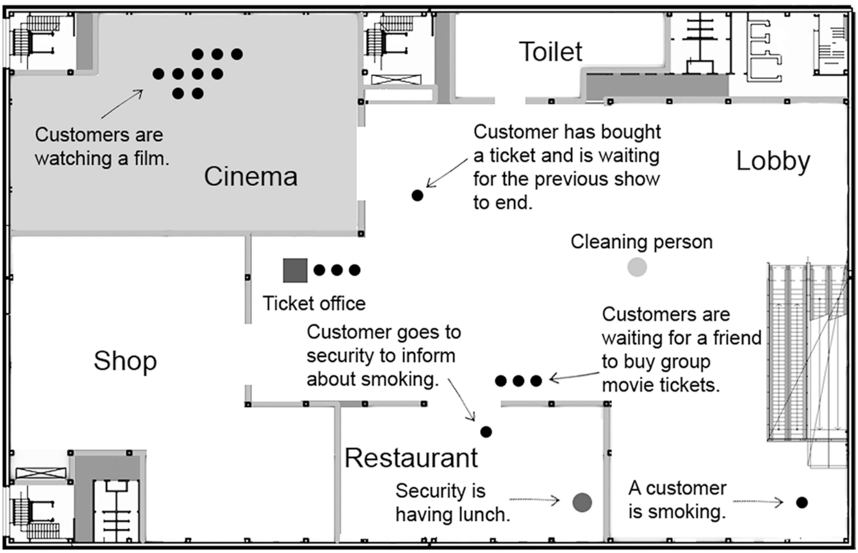

Fig. 9.1 Illustration of the simulation environment: a shopping mall. *Source:* Authors (2023)

specifically concentrate on modeling the activities of customers and staff members (security guards in particular). In general, agents may participate in activities individually or by collaborating with others. Their actions may give rise to ethical concerns, which constitute the particular focus of our research. Some actions and activities in the mall involve groups of agents committed to joint goals, such as going to the movies together. The ways in which groups form and organize themselves vary, increasing the complexity of the process and the need for social interaction. While group formation is a complex process in itself, it is not the main focus of this chapter. Instead, we take into account the roles played by groups of agents (if present).

In this chapter, we address the ethically relevant or moral aspects of MASes. Our overall goal is to find suitable primitives for the formalization of ethical principles and, in this manner, establish the premises for ethical modeling in multi-agent contexts. Ideally, ethical principles can be separated from operational details, and once formalized, they can be employed to analyze and answer ethically relevant questions. Our interdisciplinary approach emphasizes philosophical aspects, aiming to gain a fundamental understanding of ethically meaningful primitives from the analysis of multi-agent scenarios in the mall domain.

Rather than concentrating on the representation of norms (see, e.g., Broersen et al., 2001; Neumann 2010), we take the *modes* of *social intentionality* (Tuomela, 2007) as a starting point for our analysis, thereby adopting a *socio-ethical* approach to modeling MASes. Our long-term goal is to facilitate the implementation of MASes and their simulation as well as promote the development of agent (specification) languages. However, we do not introduce new languages in this preliminary study and instead utilize an existing one, namely, GAMA (Taillandier et al., 2019), in our illustrations and proof-of-concept implementations.

To summarize, this chapter initiates a socio-ethical viewpoint and approach to modeling BDI agency. Its main contributions include the following:

1. establishing the framework of *modes of social intentionality* for the analysis of BDI agency;
2. analyzing the grounds for moral action on the basis of the modes of action of the agents involved;

3. applying the framework in the socio-ethical modeling of an open-ended application domain (the mall domain); and
4. addressing the limitations of traditional BDI models in the formalization of ethical principles.

Multi-agent Systems

A MAS constitutes an ecosystem of computing entities, namely, *agents*, each of which solves some sub-problem as part of a larger collective endeavor. The agents in a MAS form a network by virtue of sharing knowledge and communicating with each other. Other capacities, say the ability to follow if-then rules and core behaviors such as mobility, interaction, adaptation, and learning, have been listed as their characteristics (see, e.g., Balaji & Srinivasan, 2010; Rocha et al., 2017).

Agents and Environments

An *agent A* is an entity whose *state* consists of precisely defined mental components such as beliefs, capabilities, choices, and commitments that roughly correspond to their common-sense counterparts in humans (Shoham, 1993). Additionally, *values* that are more concrete may also be relevant when characterizing states. In the field of computer science, it is a common practice to formalize the states of agents by introducing *state variables* whose values range over particular domains of interest.

The properties of the environment of a MAS are essential when it comes to designing a MAS in the first place, and they also determine how difficult it is for the MAS to achieve its goals. Environments can be roughly classified on the basis of their central characteristics, allowing us to define ranges such as *static* versus *dynamic*, or *fully observable* versus *partially observable* (Russell & Norvig, 2020). In simple MASes, it is also possible to view the environment as one agent *hosting* others (cf. typical *master-slave* architectures).

Actions

Agents in a MAS interact with each other and their environment by performing *actions*. The actions serve two primary purposes: either *observing* or *changing* the state of the MAS, which includes the states of the individual agents as well as that of the environment. In addition to actions performed by agents, *events* occurring unexpectedly in the environment may also affect the state of the MAS. The (effects of) actions and events can be defined in different ways, for example, by assigning new values to state variables on the basis of old ones.

In logic-oriented formalisms, such as STRIPS (Fikes & Nilsson, 1971), and the so-called *action languages* (Gelfond & Lifschitz, 1998), the states of a system can be described using *state predicates*, also known as *fluents*, whose truth values may change over time. The same applies to *actions*: A particular action can be performed if its *preconditions* are met. As the result of executing an action, certain fluents may receive truth values, thereby establishing the *postconditions* of the action. We describe changes such as these either as *additions* or *deletions* of predicates, which are sufficient to cover four possible cases for each fluent, namely, whether it stays/becomes true/false.

Example 9.1
Consider a customer C entering the mall. Let e and l be the names denoting the entrance and the lobby of the mall, respectively. Furthermore, let predicates next/2 and in/2 describe whether a customer is next to something or in a particular space.

Action $\text{enter}(C)$*:*

- *Precondition(s):* $\text{next}(C, e)$.
- *Addition(s):* $\text{in}(C, l)$.
- *Deletions(s):* $\text{next}(C, e)$.

Consider a particular customer c_1 *at the entrance, that is,* $\text{next}(c_1, e)$ *is true, thus enabling the action* $\text{enter}(c_1)$. *When executed,* $\text{next}(c_1, e)$ *is falsified while* $\text{in}(c_1, l)$ *becomes true.*

Group Actions

In Example 9.1, the action involves a single agent. As a result, the state of the agent changes as reflected by the modified truth values of the fluent involved. In multi-agent scenarios, we consider group actions engaging several agents.

Example 9.2
Continuing our examples, consider the act of one customer C_1 approaching another (C_2) in the same space S.

> ***Action*** approach(C_1, C_2):
>
> - *Precondition(s):* in(C_1, S), in(C_2, S).
> - *Additions(s):* next(C_1, C_2), next(C_2, C_1).

As a result, both customers remain in the space S, but they appear next to each other afterward as encoded with the fluent next/2.

As a result of a group action, the states of all agents involved may be updated. The action in Example 9.2 is asymmetric by nature, and the latter agent is merely treated as an object. The other agent might react by escaping from the situation by performing a counteraction escape(C_2, C_1), thus falsifying the fluents next(C_1, C_2) and next(C_2, C_1). These conditions are the natural pre- and postconditions for yet another group action: shake-hand(C_1, C_2).

BDI Models Formalized

Fluents describing a MAS essentially express the components of its state that are relevant for modeling. As usual, the meaning of such predicates can be decided on a case-by-case basis. For instance, in our shopping mall domain, if in(C, S) is true for a particular customer C and a space S, then

C is in S. Ethical aspects, however, cannot be directly formalized using state predicates, since the mental states of agents matter as well. To this end, one prevailing approach captures the *beliefs*, *desires*, and *intentions* of agents as meta-level concepts. In the sequel, we follow Labrou and Finin (1994) and formalize these concepts in terms of *modal operators* B_A, D_A, and I_A associated with an agent A. For now, we restrict the application of these operators only to fluents or their negations, hence forbidding nesting. This is primarily to mitigate computational complexity and facilitate implementation.

Example 9.3
Consider a customer C who wants to see a movie M in a particular theatre t of the mall.

Action buy-ticket(C, M):

- *Precondition(s):* $\mathcal{I}_C$(watch(C, M)), in(C, t).
- *Additions(s):* has-ticket(C, M, t).

Ticket possession is one of the natural preconditions for seeing a movie.

Action watch(C, M):

- *Precondition(s):* in(C, t), has-ticket(C, M, t), $\mathcal{I}_C$(watch(C, M)), showtime(C, M, t).
- *Deletions(s):* has-ticket(C, M, t), $\mathcal{I}_C$(watch(C, M)).

In the above, the mental state of the customer is updated accordingly, that is, the intention of seeing the movie is falsified.

The management of desires is an independent aspect: Persistent desires can be maintained indefinitely, while those that are more one-time by nature can be abandoned by falsifying $D_C(D)$.

Philosophy of Action in BDI Models

Two conditions determine whether an agent *A* succeeds in performing an action: *A* must succeed in performing the planned act and, second, the effects of the act must fulfill or further the premeditated goal. The concept of human intentionality implies a *conational* and an *epistemic* attitude in *A*: The goal of the intended action is something the agent desires, wishes, or wants to achieve or make real, and the agent knows, believes, or hopes that the intended action is a means to realize it. The BDI model that conceptualizes agency in terms of beliefs, desires, and intentions fundamentally aligns with these conditions. Thus, by providing a MAS with a set of agents that fulfill the conditions of the BDI model, we can establish a connection between the MAS and the philosophical concept of human action (Adam & Gaudou, 2015).

BDI agents have been analyzed in relation to their usability in different types of social simulations (Adam & Gaudou, 2015). The advantage of utilizing a BDI model is that it supports a large variety of agent architectures, such as a particle- or a rule-based architecture, a neural network, or a cognitive architecture.

By designing different types of cognitive architectures within the BDI framework, it is possible to simulate reasoning, norm-based behavior, and decision-making processes as well as study the effects of interaction between agents. Agents modeled according to BDI are more akin to real human beings and are better at mimicking their behavior than agents based on the psychological concepts of cognitive science. The BDI model concentrates on the conscious and the observable level of agent behavior instead of focusing on the—often—unconscious psychological states of the agent. The model provides a common-sense understanding of how desires, currently held information, and communication with others affect behavior (Adam & Gaudou, 2015).

Modes of Social Action

The conceptual tools for addressing human MASes stem from the philosophy of sociality. We can distinguish between different types of cooperation depending on *A*'s intentionality and attitude toward other agents in the group. Following Tuomela (2007), we can distinguish the following three modes of multi-agent cooperation on the basis of social intentionality: *pure I-mode*, *progroup I-mode*, and *we-mode* social intentionality.

The differences between the three modes of intentionality become clear when we highlight the relationship between *A* and the other agents involved in cooperation. The group of other agents may be described as a *surrounding*, an *instrument*, or an *end in itself* for *A*, depending on *A*'s mode of intentionality. We sum up the specific features of the three modes in what follows:

In *pure I-mode action*, *A* acts within the group that provides a *surrounding* for the actions of its members.

Example 9.4
By entering the shopping mall, customer C_1 becomes a member of a pure I-mode group, see Example 9.1.

Group membership in pure I-mode action is based on each agent's (some) individual intention that happens to be similar to (at least one of) the current individual intentions of the other agents. Customers at a shopping mall constitute a group in terms of their individual intentions to be at the shopping mall at a given moment. What other agents do affects *A*'s conditions of actions, and each may enter or leave the mall for their individual reasons and as they wish. Agent *A* may sabotage pure I-mode cooperation by preventing others from participating in the common activity, as would happen if *A* started to pester other customers at the mall.

Cooperation in *progroup I-mode* presupposes that all members of the group commit themselves, first, to the same goal and, second, to each other and each other's part in the cooperation. Acting in the group offers *instrumental value* to its members, as each of them can achieve their individual goal—which is common for all members—better by acting in the group than trying to realize it alone. Goal achievement may involve *division of labor* by *delegating* and *dividing* tasks among subgroups or individual members. AI identifying these *roles* enables the group as a whole to perform *concurrent* actions.

Acting in a group now presupposes that *A* does not act in a *counter-productive* manner, for example, by hindering others from achieving the common goal or by sabotaging the initiatives of other group members, as would happen if say customer C_2 turns down customer C_1's offer to shake hands (see the text following Example 9.2.) Customer C_2's refusal to shake hands would also prevent C_1 from shaking hands, thereby ending an instance of progroup I-mode action.

The group may adopt several goals that must be set in a priority order for their effective realization. Then *A* may have to *compete* with other group members as to whose current interests will be given most weightage. As a member of this type of a group, *A* may have to work toward reaching aims other than *A*'s individual goals. Cooperating in the group is a price that *A* pays for the instrumental value of the group as a *means* to ensure *reciprocity* between the members of the group. By agreeing to further the group's aims, *A* has a better chance of getting the group to work toward an aim closer to *A*'s interests. Such compromises and trade-offs are signs of valuing *fairness* in cooperation.

Example 9.5
A group of friends has agreed to meet at the shopping mall to get movie tickets at a group discount price for a film they all wish to see. The group members share A's aim to see the film and going together has instrumental value: The ticket is cheaper. The group may divide tasks as to who buys the tickets, who takes care of snacks, and who reserves a table at a restaurant after the movie.

We-mode intentionality involves *A* having two intended goals: first, to take part in realizing the aim that justifies the existence of the group, that is, the group goal, and second, to do *A*'s part in keeping the group together by enabling its members to act as a group. The group is now also an *end in itself* for *A*, not just an instrument to realize a goal. This type of cooperation requires strong and often long-term commitment, as the group members must commit themselves both to the shared aim and to the group as a totality, as well as to the members of the group as parts of the whole.

Example 9.6
A team of security guards often functions in we-mode. They share the interest of each security guard S doing their own part in the job during their shift as well as help their coworkers execute their part according to the principle: one for all and all for one. The team is not just an instrument for each S to execute their duties but has value in itself for its members.

Distinguishing between the different modes of social action helps explicate the significance that other group members' desires, intentions, and attitudes hold for *A* and determine *A*'s possibilities of realizing the desired goals. Action based on cooperation becomes impossible if those who form a group cannot *trust* each other. Although there are different ways to formalize trust, the common feature among all trust models is that they are computational methods used for calculating *A*'s trust in a trustee *T*, (see Koster et al., 2013).

The three modes of social action constitute a theoretical model for analyzing different types of cooperation in terms of the bonds holding the agents together as members of a group and their commitments to each other, the group as a whole, and the cooperation. In real life, people mostly act according to unspoken but internalized social conventions and practices that direct human behavior. People are raised and socialized to follow culturally determined norms, and they comply with them even in a crowd where encounters between individuals are random. The three modes of social action all deal with positive instances of cooperation, presupposing that partaking in social action fulfills some individual interest of each agent. Actions based on progroup I-mode and we-mode represent cooperation in which the group members commit themselves to the common task, aiming for the desired outcome and showing their commitment to each other. We would require different types of conceptual tools for addressing offensive and negative action as the three modes of social intentionality discussed above do not cover such situations.

As the modes each provide a distinct way to display different degrees of social intentionality, we have to integrate them into our modeling process. First, we have to choose between implicit and explicit modeling. To discuss the properties of these two options, we present a simple case where the mode changes.

Example 9.7
It is almost noon and a security guard decides to take a lunch break. The guard, currently acting in we-mode, switches to pure I-mode for the duration of the lunch break to take a break from work activities. While in pure I-mode, the guard is not interested in the tasks of the group of guards; however, that task is still dormant in the background. If a relevant event (e.g., emergency) were to take place during the lunch break, the guard might switch back to we-mode, joining the operations of the group of guards.

We can attempt to model this example implicitly, that is, by deciding that each intention of the security guard is related to a specific mode. Therefore, the change of intention would also signify a change of mode, and the actions that change the state of the MAS would be written in a manner that takes the modes into account. The modes would be present implicitly in the definition of actions but not explicitly defined. For example, each action that takes the security guard closer to eating would not include the execution of work tasks for sure. There is an issue here, however. We may wish an agent to reach the same target condition of an intention in different ways by acting in various modes. The solution is to explicitly record the mode of action when committing to an intention.

Example 9.8
Security guard S commits to having lunch in some restaurant R of the mall in pure I-mode (im):

Action commit_to_lunch(S, R)*:*

- *Precondition(s):* $\mathcal{D}_S(\text{lunch}(R))$.
- *Addition(s):* $\mathcal{I}_S(\text{lunch}(R)),\ \text{mode}(S, \text{lunch}(R), im)$.

Moral Action

In the context of human agency, an agent *A* must be *morally responsible*: People are blamed and praised for what they do. Moral blame implies an obligation to repair the harm caused and to ask those who have been harmed for forgiveness. The society prosecutes and punishes those who engage in such harmful deeds according to its legislation. Morally praiseworthy actions are favorable for others and deserve positive acknowledgment. As such, responsibility is too strict a condition for non-human agents (Hallamaa & Kalliokoski, 2020).

From the point of view of moral consideration, based on von Wright (1968), the goal of any action represents a *value*, which is something an agent regards as good, beneficial, or favorable in relation to its (present) interests. In general, goals that are beneficial for other agents, too, are *morally good*. If realizing the goal does not affect other agents' well-being, it is *morally neutral*. Morally good and neutral goals are *morally permissible*. Goals that directly harm other agents are *morally bad* and can even be defined as *morally evil*, if the harm is intended by (part of) *A*'s action. It is morally *forbidden* for *A* to set such goals and to try to reach them through actions.

Actions, too, can be divided into three categories depending on their *moral permissibility*. In general, acts that are good, beneficial, or favorable in terms of their consequences to other agents are morally good, acts that do not affect the well-being of others are morally neutral, and acts that harm other agents are morally bad or evil. The morally good and neutral acts belong to the category of permissible acts, whereas the morally bad acts are classified as forbidden acts. Acts often yield different outcomes for different parties depending on their position in the situation. The same act can thus be both favorable and unfavorable. If the act itself is not forbidden, assessing its moral value often includes weighing the outcomes for those involved.

Example 9.9

The customers are free to choose their goals from the set of actions that do not harm or hinder the functioning of the shopping mall, which, normally, consist *of morally neutral acts such as making purchases, enjoying a meal, and resting one's feet on a bench. Likewise, the customers should not (try to) do anything that would inhibit or hinder other customers and staff from setting their own goals and performing acts that are appropriate instances of behavior in the shopping mall context.*

In exceptional cases, morally forbidden acts may be permissible if *A*'s aim is to preserve something of (great) value, and the likely outcome of the harmful action is (expected to be) more positive than the anticipated outcome of *A* not performing the action.

Example 9.10

A security guard S may use physical force to hinder customer C_1 *from punching* C_2.

Some of the permissible acts are *required* or *compulsory*, and *A* has a moral *obligation* to perform them in a certain situation or context. A conceptual connection exists between what is permissible and compulsory in the following manner: All compulsory acts are permissible, and none of the impermissible acts are compulsory.

Example 9.11

The customers must finish their purchases and leave the shopping mall when the closing time is approaching. The guards have an obligation based on their duties to ensure that the customers leave the premises. The same applies to emergency situations: The sounding of the fire alarm indicates that the customers must leave the mall immediately, disregarding what they are doing, and the guards must help them by showing the way out and making sure everyone is safe.

The forbidden acts are, by definition, *unfavorable*, and this is why there is a common interest in curbing or *preventing* them. The permissible acts, for their part, can be categorized depending on how *favorable* they are in terms of their effects on others. Between the classes of forbidden and permissible acts, there lies a class of unfavorable acts. Moral acts contribute to the good of others, often enhancing their well-being.

Example 9.12
A security guard S assists a customer C who is looking for a place or an object P (e.g., a toilet, a garbage bin, the cinema).

The different modes of social intentionality we have discussed imply certain moral features, as *A* is not able to engage itself in any positive cooperation with other agents without refraining from harming them and committing itself to doing its own part in the joint venture. To model the cognitive states and reasoning behind such an action would require a much more detailed BDI architecture than is possible to present within the scope of the present chapter. This might include implementing case-based reasoning in terms of the favorability of the probable outcomes of *A*'s actions and a structure of deontic logic covering the concepts of obligation, permission, and forbidden (see Honarvar & Ghasem-Aghaee, 2009).

Modeling and Implementation

Several agent languages and related tool sets are available for modeling and simulating MASes based on BDI agents (Adam & Gaudou, 2015). One of these toolsets is GAMA (Taillandier et al., 2019), a modeling and simulation environment that focuses on spatial modeling where specifications are written using the GAML language. The GAMA platform provides resources for building simulations within the framework of the classic BDI paradigm that is based on the philosophy of action (Bratman, 1987). Due to the provided support for spatial modeling and graphical visualization, we decided to implement our BDI models utilizing GAMA as our execution platform. These features are highly useful when it comes to modeling the shopping mall domain (see Fig. 9.1). Figure 9.1 illustrates the floor plan of a conventional shopping mall containing walkable areas: a lobby, a movie theater, a restaurant, and a toilet.

A model's entities, processes, and activities were formalized in GAML in terms of *agents*, which, in turn, were specified by their *species*, each with their own attributes, actions, and behaviors. An instance of a species can perform *actions*. The *action* is a function if it can return a value and a procedure if it cannot. A simple example of a procedure is the action of movement to some point:

```
do goto target: {348,391} ;
```

With a function, we assign the returned value to a variable (here referred to as the *point* type):

```
point target <- find_target(arguments) ;
```

The most critical feature of the BDI architecture is a *plan*, which defines an order of statements that are performed to fulfill some intention. Partial plans created at the time of designing can greatly reduce computational complexity (Bordini et al., 2007); hence, we used plans as offered by GAMA, although we do not touch plans in this chapter. The simplest plan in our simulation was wandering within the space limits:

```
species cleaning_person skills: [moving] control:
    simple_bdi {
  plan lets_wander intention: find_litter {
    do wander bounds: free_space ;
  }...}
```

An agent can *perceive* the environment and change its behavior, mental state, social links, and the like on the basis of the knowledge it acquires. Agents can also interact with each other and change each other's attributes and behavior by means of the *ask* statement (see Example 9.13).

To manage time, GAMA operates using three global variables: cycle (an integer incremented by 1 at each step of the simulation), step (the modifiable duration of a simulation step; 1 second by default), and time (the actual time since the beginning).

To specify the examples described in the chapter, we first described our actions. We first identified the participants, preconditions, and possible additions and deletions. The GAMA implementation was required to follow the rules we had defined and act as an executable specification. Example 9.13 continues from the case of the security guard on a lunch break presented in Example 9.8.

Example 9.13
Customer C_1 is next to customer C_2 and notices that C_2 is smoking, that is, smoking(C_2) *is true, in a location L. Customer C_1 stores this information as a belief in addition to the location of C_2. Customer C_1 also develops an intention of sharing information with a guard in we-mode.*

Action observe_smoking(C_1, C_2, L):

- *Preconditions:* next(C_1, C_2), smoking(C_2).
- *Addition(s):* $\mathcal{B}_{C_1}$(smoking(C_2)), $\mathcal{B}_{C_1}$(in(C_2, L)), $\mathcal{I}_{C_1}$(give_information(S)), mode$(C_1$, give_information$(S), wm)$.

Security guard S needs to be in progroup I-mode or we-mode to help a customer C. Thus, it may happen that S enters we-mode (and commits to the intention to guard the mall, depicted by the predicate patrol(S)*) when S and C come next to one another if S is not in that mode at the time. In some cases, S may not be able to enter progroup I-mode or we-mode, and, thus, will not be able to help C. This alternate case is omitted here.*

Action commit_to_help_after_approach(C, S):

- *Preconditions:* next(C, S), $\mathcal{D}_S$(patrol(S)), $\neg\mathcal{I}_S$(patrol(S)).
- *Addition(s):* $\mathcal{I}_S$(patrol(S)), mode$(S$, patrol$(S), wm)$.

Customer C_1 informs security guard S about customer C_2 smoking in location L.

Action inform_of_smoking(C_1, C_2, S, L):

- *Preconditions:* mode$(S,$ patrol$(S), wm)$, $\mathcal{B}_{C_1}($smoking$(C_2))$, $\mathcal{B}_{C_1}($in$(C_2, L))$, next(C_1, S), $\mathcal{I}_{C_1}($give_information$(S))$.
- *Additions(s):* $\mathcal{B}_S($smoking$(C_2))$, $\mathcal{B}_S($in$(C_2, L))$.
- *Deletion(s):* $\mathcal{I}_{C_1}($give_information$(S))$.

In the GAMA implementation, each customer is observing the area within its viewing distance. If customer C_1 notices another customer C_2 smoking (checking the Boolean smoking *feature), C_1 obtains a new belief containing C_2's location and develops a desire to approach the security S (if such a desire is not already present in C_1). Customer C_1 approaches S, and if the latter is in progroup I-mode or we-mode, C_1 shares its belief about the smoker's location within the* inform_security *plan. If S is in pure I-mode, C_1 first attracts S's attention and asks to receive the* react_to_customer *intention. S then decides whether he wants to abandon the pure I-mode and listen to the customer or not. With the probability of 50%, S shows that he is ready to be informed and asks the customer to proceed with the* inform_security *plan. Otherwise, S stops reacting to the customer, and the latter abandons the* approach_security *plan but does not receive an intention to share his knowledge. For the sake of brevity, the code below has been simplified.*

```
species customer ... {
...
  perceive target: customer in: view_dist {
    if self.smoking = true and myself.get_desire_with_name
      (name: "approach security") = nil {
      add_belief(new_predicate(smoking,
          ["location"::self.location]));
      do add_desire(approach_security);}}

  plan approach_security_plan intention: approach_security {
    if (location distance_to security < size) {
          // if the security is close enough
      if security.mode = "pure I-mode" {
        ask security {
          do add_intention(react_to_customer);
          focus_customer <- myself.name ;
        }
        do remove_intention(approach_security);
      } else {
        remove_intention(approach_security);
        do add_intention(inform_security);
      }
    } else {
      do goto: security}}

  plan inform_security_plan intention: inform_security {
    smoking_location <- ... // extraction of the
        coordinates from the focus_customer's belief base
    ask security {
      do add_belief(new_predicate(smoking,["location"::
                                   smoking_location]));
    }
    do remove_belief(new_predicate(smoking,["location"::
                                         smoking_location]));
    remove_intention(inform_security);
}}

species security ... {
  plan react_to_customer_plan intention: react_to_customer {
    if flip(0.5) { // the probability of reaction is 50%
      mode <- "we-mode";
      do add_intention(patrol);
      ask current_customer {
        do add_intention(inform_security) ;
      }
      do remove_intention(react_to_customer, false);
    } else {
      do remove_intention(react_to_customer, false);
}}}
```

Related Research

Bosse et al. (2011) created a model for describing the reasoning process of other agents utilizing the BDI concepts, namely, beliefs, desires, and intentions, and the theory of mind. Norling (2004) utilized BDI features that resemble folk psychology to incorporate psychological abilities such as knowledge acquisition and decision-making into agent modeling. Adam et al. (2009) proposed a logical formalization to embed emotions into agent models. Cranefield and Dignum (2019) suggested a way to integrate social aspects into BDI agent systems by modeling social practices.

To inhibit unwanted outcomes of actions, there must be constraints in place that rule out as many of such consequences as possible. Norms are deontic statements that are employed to define which (types of) desires and intentions *A* must not try to realize through actions. Traditional approaches to reasoning pertaining to norms are based on modal logic (Garson, 2021) and, in particular, *deontic logic*, which can be utilized to formalize obligations and permissions concerning conditions, in analogy to using modal operators in the description of BDI systems.

Criado et al. (2010) extended BDI concepts to model agents that can make pragmatic, autonomous decisions by considering which norms to follow and how to apply them. Such extensions are possible in our approach, enriching the selection of conditions available for modeling. The same can be stated about aspects of time (see, e.g., Urlings et al., 2006) and temporal operators, since obligations and their fulfillment have implications for the past and future.

When considering agent functionality in general, the ability to construct *plans* for the realization of goals and intentions is central, and the same holds true in the context of BDI systems (see, e.g., de Silva et al., 2009; Sardiña et al., 2006) for the *hierarchical* case. Since our approach is compatible with the traditional STRIPS-style planning (Fikes & Nilsson, 1971), we may cover scenarios involving concrete planning or related *verification* tasks. However, for the time being, we have concentrated more on reflexive agents and their use in simulations. A related concept is *crowd simulation* (Cho et al., 2008) that is also relevant to the shopping mall domain but beyond the purview of our focus for now.

Discussion and Conclusions

This chapter approaches the social dimension of actions performed by agents in terms of modes of social intentionality. The three modes, namely, *pure I-mode*, *progroup I-mode*, and *we-mode*, characterize the interacting agent's intention toward engaging in social relationships with other agents that are relevant to the intended goal and the action being performed. The modes can be applied in various ways in the analysis, definition, and implementation of MASes. First of all, they can be used *implicitly* when modeling actions to understand their true nature and to ease their formalization in general.

The models produced provide possibilities for analyzing, verifying, and simulating agents' behavior. If modes are *explicitly* introduced as variables or conditions in modeling, then a more refined control over execution is enabled via the preconditions of actions. In addition, actions may also manipulate modes as needed if the agents' social intentions change over time, for example, as reactions to other agent's actions or events occurring in the environment. The three modes allow the analysis of positive instances of social action but do not lend themselves to model actions that are disruptive in terms of cooperation as such. In this respect, new conditions of intentionality could be taken into consideration as potential extensions of Tuomela's research (Tuomela, 2007).

Our chapter has, to some extent, been constrained by the limitations of the BDI model itself, which focuses on the three modalities involved, and there is no straightforward way to express the three modes of social intentionality with them. Rather, it was deemed necessary to incorporate modes as factual truths in terms of fluents (cf. the mode/3 predicate) as part of the agents' states. In reality, agents have much more complex desires and social intentions that can be realized in a number of different ways, each of which could be modeled as a separate plan that further comprises steps involving intentions. Such a recursive structure seems extensive, but without it, a large amount of the specification moves to program code. A major step in our future work will be to tackle these limitations. There are also notable aspects in modeling that have been left unaddressed and will be considered in future work. Most importantly, the progroup-I-mode and the we-mode presume a group of peer agents. The group dynamics (forming and maintaining groups) and premises for trust are complicated issues in themselves that warrant further attention in the future.

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10

Simulated Trust: Creating Situational Awareness in a Multi-actor Security Exercise

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Introduction: Security Generated Together

“A safe and secure city is made together!” This is a commonly heard co-creation tag line in numerous events where security specialists and stakeholders convene. However, what does this togetherness imply? How is it specifically enacted in command centers or situation rooms of stadiums and other venues with tens if not hundreds or thousands of soccer fans or festival goers? Can advanced technological tools enable shared situational awareness that goes beyond actor-specific situational pictures?

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This chapter introduces two preparedness drills conducted in the form of a simulated security exercise for large concert and sports events held in Tampere, Finland. The simulations involved both public authorities and private security actors—just like most real-life situations do. While the police have a universal mandate to protect security, maintain order, and prevent criminal action, other actors perform their tasks from a more limited institutional standing. This general setting is theorized here from the perspectives of public management and governance. Empirically, we trace two topics: (1) How important were the preparedness drills to the participants' joint (or interagency) action, and (2) how did the participants perceive the technologies utilized in the simulations.

Urban environments—where the simulated events took place—*are* not just amalgamations of technologies and organizations with their qualified individuals but also of artefacts and non-human actors (Beauregard, 2015; Lieto, 2017; Leino et al., 2017). This complex setting is also where public trust is placed in the belief that concerted action under competent leadership can yield tangible benefits. In the event context, as simulated in the preparedness drill, the following should be added:

1. The event-goers' and townspeople's first-person experiences of feeling secure in a meaningful way (cf. Flanagan, 2009; Spithoven, 2017).
2. The overall positive experience that event participation and utilization of urban amenities evokes (ambience/atmosphere), and through these perceived benefits.
3. The overall legitimacy of the entire sociotechnical assemblage dedicated to enhancing safety and security of (and in) events and urban environments.

Trust constitutes the general framework for this chapter. It is understood here in an unpretentiously pragmatic manner as a condition for different actors to engage in a shared frame of action and cooperate. As an element of cooperation, trust or its key conditions can be enacted, either through regulation or enhancement (Nooteboom et al., 1997; Oomsels & Bouckaert, 2014; cf. Axelrod, 1984). As an *idea*, enhancing trust is firmly entrenched in the Western culture. It can be traced back to the *Golden Rule* or the *Categorical Imperative* (Kant, 1785/2005; cf.

Nooteboom, 2022) that call for reciprocity and due intersubjectivity. Nooteboom et al. (1997) even operationalized the enhancement of trust; however, the roles of the individual, institutional/governance, and technological elements present in a joint action frame still defy a strictly structured explanation.

While designing and developing instruments and methods for pursuing the above ultimate goals related to trust, we find ourselves facing yet another challenging question that addresses our necessary insight and even the metrics we use to guide and direct our pursuit:

- Are we nimble enough to know *where (and what) to look for* and *how to measure* (a) the effectiveness of and (b) the trustfulness present in multi-actor joint security efforts?

We need to know how, where, and with which management tools and planning artefacts the agency for generating shared and mutual security is constructed. Particularly in the heat of emergency situations, and even more so in high-pressure situation rooms, it is crucial to ensure that the methods and tools that we employ for creating this commonality effectively support rather than harm the restoration and maintenance of public safety and security in any given context. This context can be an event arena designed as a "laminated" venue of thoroughly drilled security protocols and enactments (cf. Coaffee et al., 2011; Gordon et al., 2016) or an urban space with a full spectrum of uses that stem from its sociomaterial and mentally constructed fluidity (cf. Ellard, 2015; Karppi & Sankala, 2021).

In this chapter, we introduce a process with two interlinked multi-actor simulations performed with a broad community of public and private safety and security agencies and organizations. These simulations were key components of the SURE project. The element that we promoted in the project was user- and stakeholder-driven development of technical solutions for achieving enhanced situational awareness and understanding in complex safety and security settings. In the following, we discuss this process from three perspectives: (1) *governance-related* (institutional constraints to cooperation), (2) *technological* (tools developed for cooperation), and (3) the situational merger of these two aspects in security actors' engagement in a preparedness drill exercise.

From Siloed Security Governance to Perceived Control and Shared Knowledge

Everything that transpires in the material world does so and becomes communicated within its more or less specific spatial, temporal, and cultural context (Nooteboom, 2001; Soja, 1989). The enactments and communications discussed in this chapter take place within the Finnish safety and security community, comprising both public and private agencies and actors. They are inseparable from the demonstrably "Finnish" features of organizational culture, enactments, and communication (Hofstede, 2002). These features include low intraorganizational power distances and hierarchies—something that also reflects in the prerequisites for interaction and cooperation across organizational boundaries.

Organizational structures (generally known in governance literature as "silos") keep agencies and their units apart. While they exist for a reason,[1] they can and even need to be challenged. Deliberate processes for breaching them have been effected in favor of more efficient cooperation (cf. Karppi & Vakkuri, 2019). Attempts to dismantle or bypass silos for purposeful and efficient use of the resources that they marshal are central to academic interest for exploring why and how organizations and their businesses are featured the way they are. In the following, we outline some of these ideas. We start with providing a brief overview of the changing overall governance mindset in public action and continue with discussing division of labor and communication with special reference to crisis management enactments.

New public management, the great managerial tide that swept public agencies and organizations throughout the developed world in the 1990s, was, by the beginning of the twenty-first century, widely regarded as a transitionary phase to what was to come after that—the *new public governance* (Osborne, 2006). This development also paved the way for more agile governance models in the face of the nascent dimensions of the algorithmic world (Dunleavy et al., 2006). On the basis of empirical

[1] Results management and the adjoining need for detailed measuring and auditing of performance in agencies and administrative units are widely seen as key factors that cement the silos (cf. Karppi & Vakkuri, 2019).

evidence, Fattore et al. (2012) claimed that the very vocabulary and, hence, policy discourses that the new public governance facilitated were more desirable to political decision-makers than those within public management, which were deemed as clearly more technocratic.

Yet, even if administrative reforms enacted during this era were willingly blamed for pushing business logic into the public domain, a countercurrent also existed. Public bodies found new means to promote their interests while engaging private partners (Karppi & Haveri, 2009). This "policy push" demonstrates that despite all new governance ideals, the line between public and private agency is tangible, particularly so in issues of safety and security. This, we claim, can be evidenced in the new setting of cooperation, reciprocity, and other potentially trust-nurturing joint enactments. Despite all institutional challenges identified here, these enhancements still mark the cultural backbone of new public governance over the cruder, results-managed, and silo-enforcing operational logic associated with public management (Karppi & Vakkuri, *op. cit.*).

Open Systems and a Representational-Computational View on the Knowledge Challenged

Public agencies indeed have a plethora of tools at their disposal to push policy interests in processes that involve critical private contractors in the domain of security and elsewhere. This does not merely challenge governance practices but the fundamental principles of organizational thought and how we see the division of labor that follows from them. The traditional approach, largely based on general systems theory, relies on fixed boundaries and stable patterns of relationships between different actors (Schneider & Somers, 2006). It views organizations as open systems that tend toward equilibrium and growth through import of energy from their surroundings, which are infested with other organizations with their own ambitions. General systems theory understands organizational transformation as a predominantly Darwinian evolutionary process, with inevitable implications for why one organization should cooperate with others in the first place.

Division of labor among organizations requires communication and exchange of knowledge. A flow of unexpected events, unfolding in an emergency situation and requiring joint action of multiple agencies and actors, also necessitates joint knowledge creation. A dominant understanding of knowledge within cognitive sciences is provided by the representational-computational model (Nooteboom, 2001). Its key tenets such as reliance on communication through codes that are complete, exhaustive, and determinate or separation between media and the contents conveyed in them are compatible with systems theory. Moreover, as Zweibelson et al. (2021) argued, procedures and mindsets that resemble a "GST-RC combination" (general systems theory *cum* representational-computational model), as the one discussed here, are conspicuously commonplace if not outright genotypic to military professionals and security agencies.

With its strong intraorganizational view, the GST-RC combination parallels new public management as a managerial paradigm. While characteristically static, this combination does explain clearly enough our capability to understand sentences, expressions, and scripts that we have never heard before (cf. Nooteboom, 2001). This obviously is a necessary trait in communication across the boundaries that divide actors involved in various, often abruptly changing, security situations.

What has most significantly provided an alternative approach to general systems theory's institutional worldview is complexity theory and a model of complex adaptive systems. They claim that we are surrounded by a plethora of different system patterns, ranging from chaotic to stable equilibria. Moreover, while different attractors may exert dramatic impacts on a system's status, "strange attractors" render some events intrinsically unknowable and beyond the reach of our knowledge or technology until they occur (Schneider & Somers, 2006). These events pose major challenges to preparedness and crisis management and require different approaches and design practices for understanding how emergency security events and their unfolding are encountered and communicated (cf. Zweibelson et al., 2021).

Complex Adaptive Systems and a Situated Action View on Knowledge: A Solution at Hand?

First, imagine a situation room.

> A group of individuals is watching their laptop screens in a slightly dimmed room as an incident takes place somewhere at an event venue. They are the event's security commanders. One of them is a police officer, another one belongs to the fire department, and another to the emergency unit. The event's security manager completes this multisectoral team, marshalling the private security staff around the venue. Right now, they are struggling to make sense of how the incident will evolve, responding to it swiftly, resolutely, and with professionalism. They resonate through what they hold as their common interest, things they need to know for giving orders, and the general goal of keeping all event guests safe and secure. They seek to minimally disrupt the ongoing event, show, or a game: They know that by keeping the event and its venue safe, they will also protect the event sponsors' brands and their security image, and even the vitality of the entire event-hosting city.

This imaginary example offers an idea of the complex balancing act that the security team must perform between safety, security, ambience, and guest experience, in addition to meeting the fundamental requirements set by the spatial contexts of the venue itself and its surroundings. They exchange messages with on-scene commanders, determining the scope and possibly the timing of any intervention that might be needed. The greater circuit of socioeconomic governance made tangible by the enhanced significance of large events in city competition adds to the overall complexity associated with event spaces and their security by exposing the entire security organization to a new kind of criticism if the city's security image gets tainted.

Finally, all of this takes place in exceedingly technological environments, and it is important to note here that there are multiple such environments at play. Modern event venues are sociotechnical assemblages to the point that they are nothing short of "springboards" through which security and surveillance technologies with elaborate protocols for utilizing them may enter the surrounding urban spaces (Giulianotti & Klauser, 2009).[2] What was simplified above as command center "screens" actually refers to a range of communication tools from traditional duplex radio to web-based and algorithm-driven systems, each of which has an equally varied range of use protocol. Some aspects of controlling the flow of events may be simulated in a digital twin (cf. Batty, 2018), a virtual real-time model that can reproduce and mimic events and processes from the material world. Effective deployment of new technologies requires the adopting organizations to develop their own practices for domesticating them (cf. Latour, 1994; Nooteboom, 2001; Zweibelson et al., 2021).

Addressing greater complexity requires procedures that go beyond the assumptions of relative stability associated with the GST-RC combination. Instead of getting mired in a Darwinian stalemate in a command center setting, security actors need to find common grounds[3] among themselves. This need holds true even if they have different sector-specific priorities and tasks to attend to. Nooteboom (2001) helps us to turn the tables. He suggests a situated action view on cognitive structures, emphasizing their construction through action rather than the reverse (that is, actions defining cognitive structures). For Nooteboom, the vital aspects of increasing complexity constitute key elements of the situated action approach: knowledge is created attached to the physical world, social interaction, and technological tinkering. Individual learning through joint action in a situation room setting—technological systems included—is perceived as conductive to organizational learning that may contribute to institutional practices that can facilitate joint action.

The practical implication of all this is the importance of defining the role of situation room settings. They are not mere platforms for enhancing the efficiency of sector-specific actions. Instead, through common actions and reflexive practices (cf. Zweibelson et al., 2021), individuals

[2] The first steps toward the public urban space are taken in the extensively monitored "fan zones" that are thought to tone down tensions and social exclusion associated with high ticket prices in commodified professional sports events as well as black ticket markets (*op. cit.*).

[3] "Finding a common ground" cannot be their ultimate aim, however, as it would ultimately expose the command center team to a fallacious, deceptive, and groupthink-prone consensus (cf. Janis, 1982).

may find their existing knowledge inadequate. This requires them to tune into "learner's mode" (Lichtenstein et al., 2006; Karppi & Vakkuri, 2019)—an evident precondition to boundary work.

The combination of CAS-SA (complex adaptive systems and situated action), in its emphatically non-Darwinian guise, does not rely on the role of individual "leaders." Instead, it promotes leadership as a collective endeavor that emerges through identifiable episodes and events. Typically, this is expected to take place in a team of executives or experts, which includes a situation room setting with complementary competences among the security team members. The greatest potentials of CAS-SA may be manifest in situations where several security actors *simultaneously* produce a shared situational awareness or understanding and perform their primary tasks. These tasks constitute the sole responsibility of each individual actor, irrespective of the eventual overlaps or collisions with other actors' institutionally determined tasks and responsibilities. These overlaps and collisions, as well as conceivable synergies, are the objects of learning and future evolution. Thus, fostering shared awareness can be deemed as a trustful act.

Situation Picture, Situational Awareness, and Situational Understanding: The Simulations

According to Tikanmäki and Ruoslahti (2019), common situation(al) awareness is not a precondition for expert organizations' cooperation. Instead, the authors add, it is necessary that the organizations share a common understanding on a conceptual level. They highlighted that a combination of situation awareness(es) and communication constitutes the elementary building block for cooperation. Meanwhile, (a potentially fruitless) pursuit of common situation awareness alone may even be harmful for the expert organizations' joint action.

From this, it can be concluded that the problem lies in finding a balance between the contextual commonalities and the shared knowledge that the participants of a joint action need for efficient enactments and the fulfillment of organization-specific tasks and responsibilities. The same can be said of the technologies and the entire sociomaterial basis of action[4] that enables efficient command and control. This also helps to determine and manage efficient response, and the balancing between shared and actor-specific elements was what held our interest in the multi-actor simulation exercises. Moreover, the simulations were utilized as platforms for discerning the impact of technical solutions on joint sense-making. The employment of technology was tested in different kinds of security situations and the design of the consecutive simulation exercises was grounded in exhaustive group interviews with all participating actors. All this was believed to resonate with the situated action approach (see above) and promote trust on the basis of continuous communication and learning from cooperation (cf. Nooteboom, 2004).

The overall framework for studying the impact of various individual, social, institutional, and technological elements[5] was based on two simulation exercises, the first of which was held in June 2021 and the second in April 2022. The first simulation dealt with the large Blockfest hip-hop festival held in a traditional open-air stadium environment, and the second was focused on the 2022 Ice Hockey World Championship tournament held in a new multi-purpose arena (cf. Karppi & Sankala in this volume). Both simulations, thus, dealt with real-life mass urban events in Tampere and involved security professionals on active duty in different roles. The first simulation took place at Tampere emergency management facilities, while for the second simulation, a situation room was built at the Nokia Arena, the actual tournament site. Both simulations took place within some weeks of the actual events, and a series of event- and location-specific situation scenarios and planning workshops were organized with all involved stakeholders from the spring of 2020 onward.

[4] This can be portrayed as a triangular relationship that connects the artefacts utilized for command and control, the object of control (urban space, event venue, and the like), and the subjects with a particular agency in commanding and controlling. For a long time, the latter was an emphatically human domain; however, in surveillance of both event and public urban spaces, humans and non-humans (particularly AI algorithms) now increasingly share the agency among themselves.

[5] Understood broadly as drivers, enablers of constraints depending on the individual actors, and as representatives of a variety of security agencies and actors, with their respective competences or limitations.

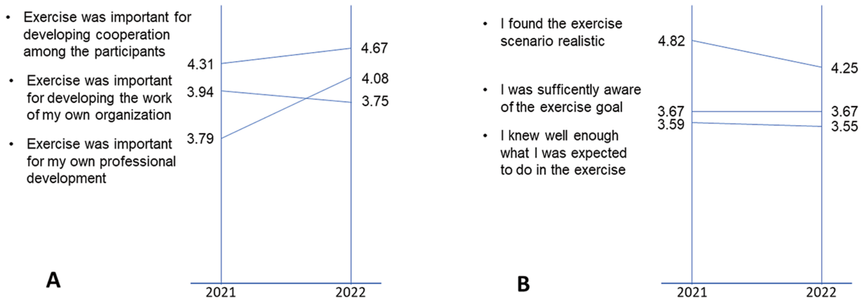

Fig. 10.1 Participant's perceptions of the two SURE simulations held in 2021 and 2022 on a five-point Likert scale. *Source:* Authors (2023)

Figure 10.1 illustrates the participants' responses to statements (translated from Finnish) on the two simulation exercises. The first three responses (Fig. 10.1a) address the exercises' deemed overall significance to the participating institutions, and the next three (Fig. 10.1b) shed light on the participant's personal attachment to what was exercised. We employed a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). While the exercise was generally well received, some interesting differences also emerged.

Findings: Adding Details Does Not Always Enhance Realism

The first simulation took place in adherence to strict COVID-19 restrictions, setting limits to the form of the exercise. The participants primarily represented public security and safety agencies that sent several senior staff members for the exercise. The participants convened in the shared premises, but for health security reasons, they were divided into small teams and placed in separate rooms. Thus, a majority of the teams performed the exercise online, while only one of the teams was physically present in the main venue with the exercise leadership. Interactive elements were not available, and all materials (maps, illustrations) were static and presented by the moderator. The manuscript, however, had been jointly prepared in co-design workshops with the participating security agencies and actors. An assessment of the successes and failures of the simulation was conducted as an "official" part of the exercise, and its findings were utilized in the preparation of the second simulation.

The second simulation was conducted with minimal COVID-19 restrictions in place. In it, the number of participating individuals from each participating organization was limited to two or three (see Table 10.1). This was done to ensure an active role for every participant. Technical support was available to facilitate the use of a joint situational awareness and communication platform that was directly used by each participant (cf. Appendix). A great number of pre-recorded and carefully designed materials were employed to support the storyline that was narrated by a facilitator. The participants were met with a day before the actual simulation. Together with the SURE simulation team, they visited the actual locations where the simulation scenario was to be played out. They also acquainted themselves with the tools to be used in the exercise to get an idea of how the field-to-situation room information transmission would take place. The field trip was followed by a joint debriefing session for clarifying any technical or scenario-related issues for the next day's exercise. Thus, for the participants, the second simulation was far richer in terms of information, detailed material, and tools for making the exercised scenario feel more realistic as well as enhancing the participants' preparedness.

Table 10.1 Participants of the two SURE simulations

SURE emergency drill simulations: participating agencies and entities	
June 2021	*April 2022*
• Central Finland Police Department • Pirkanmaa Rescue Department • Pirkanmaa Hospital District Emergency Services • City of Tampere Social and crisis stand-by service • Emergency Response Centre Agency • Finnish Red Cross • Event security corporation	• Central Finland Police Department • Pirkanmaa Rescue Department • Pirkanmaa Hospital District Emergency Services • City of Tampere Social and crisis stand-by service • Event security corporation • Venue security guard representation

However, as Fig. 10.1b illustrates, this richness did not automatically contribute to experienced realism or a sense of control over what happened at the exercise. This, we believe, was largely due to the reservations of some of the participating agencies toward the second simulation's scenario. The 2021 scenario was based on a real incident that had occurred at a previous music festival and involved a fire due to a damaged technical instrument. Therefore, it was largely within the scope of standard or "acceptable" incidents with existing institutional procedures. Moreover, as its setting was Tampere Stadium, a traditional venue for large-scale sports events and concerts that is well known to all safety and security agencies, it involved a minimal need (or *risk*) for any improvised action. The 2022 scenario was a suspected terrorist act with an activist group bringing and planting possibly several explosives into a new event arena. Thus, the scenario involved a great number of contingencies compared with the previous one and clearly stripped the participating agencies of ready-made protocols or situational manuscripts for counteracting the threat (cf. Zweibelson et al., 2021). This scenario led the participants to a much more uncommon terrain. Finally, compared with the relative ubiquity of the first scenario setting, terrorist acts in international sports events have been entirely unexperienced in Finland.

Shared Situational Understanding Challenged by Siloed Security

The administratively distributed capacity to govern complex phenomena such as security is a challenging point of departure. We talk customarily about administrative silos that are consequences of division of labor in systems that have grown increasingly specialized. As systems for alleviating perceived complexity in the interface between an organization and its environment, these administrative silos can be viewed as fundamentally rational constructions, irrespective of their identified temporal or functional deficiencies (cf. Baudrillard, 1968/2020). Their performance is measured and rewarded on equally specialized metrics whose resulting effect (if not an outright function) is to guide every actor, division, or agency to focus on the core of the task assigned to it. To ensure maximum success in this pursuit of performance, these silos develop distinct routines, terminologies/jargons, and, eventually, (organizational) cultures linked to them. The unintended consequence of all this is that it makes their operating opaque to other actors. This makes the walls of their silos grow thicker.

It was, hence, not surprising that the participants valued highly a multi-actor exercise that presented an opportunity to discuss and share experiences with their peers at other agencies across institutional boundaries. This was particularly clear in the 2022 simulation with all physical isolations among the participants removed. For this exercise, the participants worked as one, more closely-knit team placed in one room, with all of them facing large displays with a situation map. Pre-recorded video clips of incidents showed them how the situation unfolded. Simultaneously, the laptops and software or other tools that each of them used in the exercise were their regular agency-specific ones, with only one difference: they were specially adjusted for the simulation for sharing the external situational awareness platform (IBA). The participants' appreciation of the exercise could also be clearly seen in the second simulation's assessed significance for the participants' direct professional development as well as for the work organization as a whole compared with the first simulation.

Complex societal issues typically cannot be solved by a single actor. However, solving a complex issue by bringing strongly specialized actors together engenders complexity of another nature. Karppi and Vakkuri (2020) spoke about the proxification that happens when these actors with their silo-based responsibilities encounter a task that refuses to be fitted into the world of fixed silos. The authors discussed this phenomenon in context of sustainability as a complex if not elusive goal in urban development and planning; however, the idea can be extended to the various issues within "security made together." When faced with a shared complex decision-making issue, all actors tend to define their own approach and determine their own responses. However, this may leave notable gaps that fall outside any of the actors' primary scope of responsibility. In context of public safety and security, this responsibility includes an agency that is established with distinctive formal institutions (North, 1993).

Breaking Down Silos and Enhancing Trust Through Situational Understanding

The fact that these gaps seem to be persistent does not mean that attempts to bridge them should be abandoned. After all, enabling and enhancing communication in complex crisis situations involving management structures that consist of several agencies and other actors was the very purpose of the simulation exercises. In the situated action setting (see above), communication was viewed as conducive to shared understanding, sense of commonality and, through learning over time and by repetition, trust.

In our exercise, the instrument utilized for facilitating communication maximally devoid of any ready-made institutional connotations or codes of lingual conduct was the Insta Blue Aware (IBA) platform. More than a "mere" artefact of technical sophistication, it was regarded as a particular *boundary object*. In the spirit of Star and Griesemer (1989), the platform allowed agencies and other actors to interpret and appreciate it through their own specific task. Furthermore, it served as a certain source of commonality for agencies and actors that shared the common tactical frame that the situation room itself made "real" (cf. Lipiez, 1997). This commonality is obviously challenged in actual situations by virtue of the fact that all actors involved are required to execute their statutory tasks flawlessly. Violating this requirement leads to criminal investigation by one of the actors (police) and possible indictment (Foucault, 1977).

While different kinds of limitations inhibit trustful commonality and "jointly generated security," we were particularly interested in determining if and how the use of shared technology might facilitate them. We wanted to know more about how the simulation participants viewed IBA and technology in general as a source of mutual understanding and how effective they found technology as a contributing factor to the completion of their tasks (Fig. 10.2). This aspect shifts the attention from IBA as an artefact toward its use in a particular mode of operation. Karppi and Vakkuri (2019) have called this mode *boundary work*—a setting in which the design of the entire action frame is favorable to thinning the silo boundaries. The ambiguity of the task at hand, uncertainty regarding

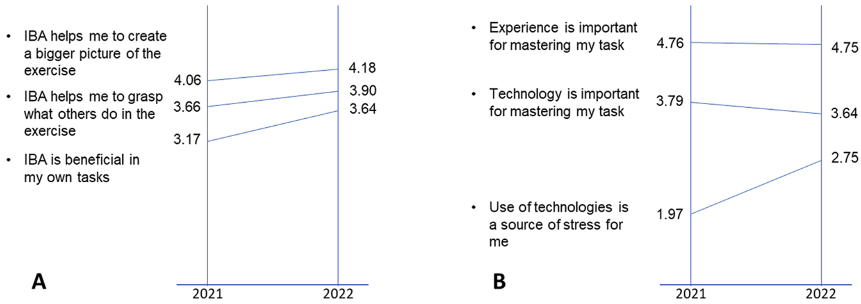

Fig. 10.2 Participants' perceptions of the IBA and the general context of using technical tools in the two SURE simulation exercises held in 2021 and 2022, on a five-point Likert scale. *Source:* Authors (2023)

leadership and other roles among the participants, or the newness or unpredictability of the scene of the events may all be incentives for participants to learn and interpret how others perceive the situation instead of clinging to predetermined institutional protocols for addressing it. An externally scripted simulation exercise where a team of safety and security actors share a new situational awareness tool may, thus, serve as a frame of action that combines elements of both boundary object and boundary work.

Particularly in the second simulation where participants had firsthand access to IBA and a first-person perspective of how the exercise narrative unfolded, the common technical platform seems to have exerted a dual impact on awareness. *First*, it contributed to a better *external* awareness of the exercise scenario itself, and *second*, it contributed to the better *internal* awareness of what the participants were accomplishing as a team. Therefore, it is not surprising that more hands-on use of IBA was regarded as benefiting the participants more in their own tasks. Yet, in this setting, participants assessed technology as a remarkably greater source of stress compared with the first simulation where the IBA was presented to the participants rather than being actively used. Interestingly, the second simulation only strengthened the idea of experience as a key resource for safety and security professionals for mastering their tasks in crisis management situations.

Moving on

Systems such as IBA can hardly be a panacea for all communication challenges present in joint crisis or emergency management situations, or even in exercises simulating them. Actor- or agency-specific situations focus on or, as Zweibelson et al. (2021) argued, are *entrenched in* messages codified with reliance on knowledge in a GST-RC format. They appear, thus, as clearly defined objects, or even agency-specific artefacts. Creating common understanding, in contrast, requires joint sense-making and shared practices to enable the best utilization of available tools that constitute entire *technological species* or "third actors" that facilitate communication across the agency boundaries. However, investment of extra effort appears to be necessary not only for trust-building across these boundaries but also for nurturing individual willingness and aptitude to use advanced tools for achieving a shared situational understanding. This resonates well with the idea of boundary work as it was defined above.

Drawing on prior experience, it can be further elaborated that boundary work benefits from a "shared ambiguity" that actors in a common social frame come to encounter. With the widening use of AI, this boundary work certainly includes encounters with emergent technological possibilities (Kissinger et al., 2021). Karppi and Vakkuri (2019) studied ambiguity in a more traditional context, involving a long-prepared but politically contested and, hence, uncertain administrative reform, and they found it conducive for breaking actors' pre-existing ways for defining the issue at hand. Karppi and Sankala (2021) discerned a related positively disruptive potential while studying a new technological platform added in an urban transit system. It is highly conceivable that new and potentially disruptive technologies that a team of safety and security professionals encounters as a task-oriented entity has more or less the same effect.

Therefore, in the SURE project, we expected some breaching (if not an entire breakdown) of agency-based entrenchments and the opening of the gates for a CAS-infused model of knowledge creation with (and *concerning*) the new technological solution with which agencies were set to replace uncertainty with a shared awareness. To a degree, this indeed appeared to be the case. Simulation participants clearly appreciated the "big picture perspective" that IBA helped convey to them, shedding light on how the simulated situation evolved in general and the location of other agencies in it. However, a group discussion with the participants after the second simulation, during which all participants had used the IBA platform, added remarkable nuances to its merits. Some participants found the tool worthwhile because it appeared relatively easy to integrate into their respective agencies' existing operational frames. It did not pose a noteworthy challenge to the agencies of changing their established and task-centered ways.

Conclusions: Tools and Technologies Enable the Construction of Common Understanding

Due to their innate complexity and the numerous interfaces with the urban space surrounding the venues, large events require cooperation between event organizers, authorities, and non-authority stakeholders. Consequently, cooperation, communication, and co-building of meaningful situational awareness are required from these actors. Technical tools support this process across the board, from providing visual feedback from the field to shaping situational understanding. Cooperation, however, is not automatic. Although a common "language" or vocabulary and shared tools are key enablers for focused joint action, Zweibelson et al. (2021) warned against the risks of convergent thinking, especially in situations that require creative solutions and thinking out of the box. Shared tools, procedures, and signaling codes should not be deployed at the cost of divergence.

Technology as an Enabler

Technology can serve as a critical enabler of boundary work conducted not only among authorities but also between authorities and non-authorities for improved communication, enrichment of shared situational awareness, and enhanced collaboration. Common (shared) situational understanding is essential, because security events (accidents, crises) often involve several actors, can be (or evolve) very complex, and can change rapidly. While these events require swift interpretation of the situation, fast analyses based on the situation, and due decision-making, this process may occur simultaneously within several agencies, depending on the scale and scope of the incident. All agencies need real-time, reliable, and correct information, in addition to the ability to share their idea of the incident and the enactments that it requires, to be able to act accordingly in concert, such that all involved agencies and actors serve the shared goal.

The survey data and observations from the simulation exercises indicate that light and agile technical solutions that can be used both in information exchange between authorities and in communication between authorities and non-authorities support the construction of common understanding and commonality—the building blocks of trust. These building blocks include cooperation, communication, and the constitution of enriched situational awareness and situational understanding. The IBA platform that was utilized in the simulation exercise was perceived as a potential tool for this kind of cooperation and awareness building. However, the exercise settings were able to provide only indirect indications or circumstantial evidence to support these arguments. Nonetheless, this evidence helped in finding answers to the key question of the chapter, which concerns the effectiveness demonstrated during the multi-actor joint security exercises and the trustfulness present in these exercises.

Technology, which, in the case of our simulations, was the IBA platform, can be viewed as a contributor to joint effectiveness and, to some extent, trust by improving common understanding. The tool was found to be particularly useful due to its ability to bring together a great deal of visual information, providing access to various surveillance, traffic control, and other cameras mounted on different urban locations, event environments, transit systems or incoming routes, and street intersections. Its ability to pool various sources of environmental data and model its impacts on the situation at hand was seen as a major advantage. Indication of the wind direction and velocity in case of a fire or chemical emission in or around an open-air event premises, along with provision of data on the location and movement of the security staff in the field or the arrival of public transportation near the site, all on one device, made it possible for each agency to not only select the data most relevant to it but also fathom the factors underlying other agencies' tactical choices.

Key Lessons Learned

Our final outcomes can be arranged under two broader themes: (1) the simulation exercises as frames of action and the technology's role in them and (2) participating agencies' cooperation across the sectoral or agency boundaries. Any success or failure in achieving a feeling of collective control in an emergency management situation involves interplay of different elements. First, every participant has to meet the necessary and even mandatory requirement of completing its own agency-specific task. Second, this task requires agency-specific situation pictures that make each agency highly selective toward the information flows.[6] Third, much depends on personal experience with using different situational awareness tools and technologies, their experienced usefulness, and the stress these tools may impose on their user.

1. *Simulation process and the tools used.* An extensive preparatory phase with two rounds of workshops involving safety and security agencies preceded the simulation. The first round was conducted in the spring of 2020 for the scenario writing for the simulations. The second round, conducted in 2021, addressed agency-specific issues. These workshops played a central role in refining the details of the simulation manuscripts. However, after the first simulation, the participants expressed the opinion that they would have benefited from a more detailed introduction of the simulation's goals as well as the methods and technologies used. This was done in the second simulation with partly mixed outcomes.

In the second exercise, static images were replaced with video clips that followed a carefully designed storyline and served as a vehicle for the

[6] Effectiveness of a joint activity requires that common situational awareness, collectively reached and shared by the agencies, to sharpen agency-specific situation pictures.

narrative. The field locations in which the clips were shot were jointly surveyed by the organizers and simulation participants. A debriefing and feedback session was arranged after the field trip, and the simulation, which was organized next day, took place at the actual locations of the simulated action. The team attending the second simulation was smaller than that in the first one. The participants had more opportunities to exchange opinions on the exercise and the technologies utilized in it. Yet, all of this exerted a mixed impact on the outcome.

The simulations enabled the construction of agency-specific rather than common situational awareness or understanding. However, the value of the latter was recognized, and it was generally agreed that joint exercises should be further developed to foster its creation. Finally, the participating agencies found IBA, the key technological platform used in the simulations, a suitable tool, especially because it *did not force them to divert too far from their established ways*. Its most appreciated feature was the sharing of visual, cartographic, and other data deemed necessary for the creation of shared situational awareness.

2. *Cooperation across sectoral boundaries.* In the exercises, the general points of reference were scenarios with situation pictures provided through ready-made images and video clips embedded in the IBA system. They were narrated to the participants by a facilitator. Whilst a correct and accurate situation picture *is* crucial for obtaining a balanced response from a given actor (authority, agency, or civilian), complex situations require cooperation that transcends sectoral boundaries and, hence, require broader situation awareness or situational understanding. This, in turn, necessitates not only readiness but also adequate institutional latitude for the participating agencies to work toward a shared goal.

Cooperation across the boundaries of administrative sectors is not easy. Nearly all consecutive governance reforms involving ministries, agencies, or any actors or bureaucracies have tried to promote it. Virtually, all organizations are easily limited by their own policies and systems for command, control, incentives, and reward. Thus, all joint activities that help mitigate the barriers to horizontal cooperation are highly meaningful, whether they involve simulating acute situations in a multi-actor setting or developing efficient tools for enabling cooperation.

Postscript: A Technological Challenge

Technology-assisted preparedness drills seek to be authentic. Unexpected turns are included in the manuscripts but typically delivered to the participants in an orderly fashion. Technologies may, thus, render the simulated events too manageable to the participants. Due to COVID-19 restrictions, the 2021 simulation relied on partly crowded and unstable online channels, as one participant pointed out:

> The crowded messaging over the web sounded just how it all comes to your headset on the scene of fire.

Appendix: Description of the IBA Situational Awareness Platform Utilized in the Simulation Exercises

IBA is an abbreviation of *Insta Blue Aware*. IBA is a product family comprising a browser application and various mobile applications. IBA has been developed by the Tampere-based Insta Advance Oy for facilitating situational awareness, task management, and communication. Its features include voice PTT, tactical chat, and live video feeds, in addition to off-line maps and alarms. IBA can be integrated with various external sources and systems.

IBA and the IBA integrations were chosen as a situational awareness platform for the SURE project, particularly due to the application's and its extensions' track record with the local hospital district emergency services—one of the project's stakeholders and beneficiaries. Having the capacity to provide the task management with the field team locations of different security actors, it also has the technical capacity to enable the construction of a shared situation picture among these actors. The latter was among the key objectives of the entire SURE project.

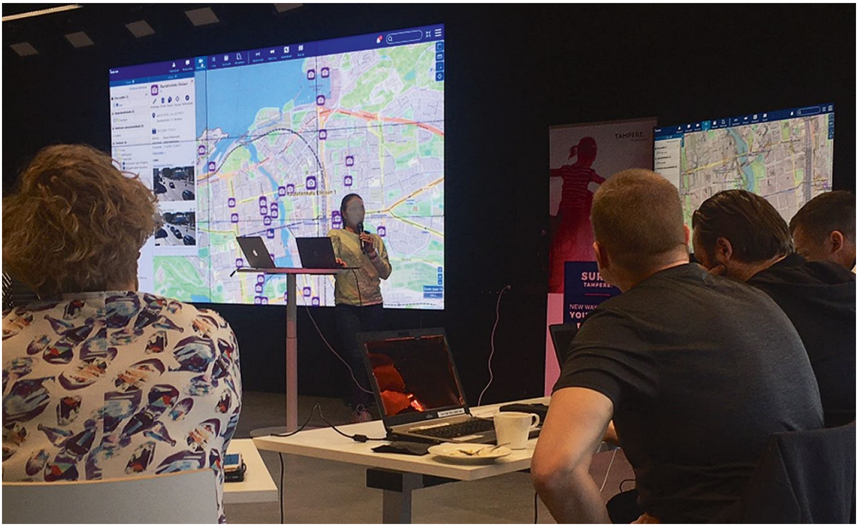

Fig. 10.3 IBA used in the SURE simulation exercise. *Source:* Ilari Karppi (2022)

Table 10.2 The IBA integrations

Moving objects	City traffic (busses, trams)
	Trains
	Actors' location information
Still objects	Defibrillators
	CO_2 sensors
	Camera-based crowd counting visualization
Video sources	City cameras
	Weather cameras
Background maps	A variety of background maps
	Weather maps
	Traffic flow

IBA also records event histories, showing, thus, how the construction of the situation picture takes place. This is a feature appreciated by those in charge of organizing joint preparedness drills and security exercises (Fig. 10.3). In the SURE project, the IBA integrations included the elements presented in Table 10.2.

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11

City Command and Control Centers as Think Tanks for Organization of Big Events

Pedro Martins, Alexandre Hojda, and Marcela de Moraes Batista Simão

List of Terms and Abbreviations

C4	City's command and control center
COR	Rio de Janeiro city hall operations center
ICT	Information and communication technologies
PO	Participation observation

Introduction

From concerts to sporting events, cities have much to gain from hosting large-scale events; however, they must also be prepared to tackle the complex logistical hurdles that accompany them. Cities' command and

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control centers (C4s) can play a crucial role in supporting cities to overcome these logistical challenges by providing real-time monitoring, communication, and coordination among different departments and agencies involved in organizing big gatherings. To fulfill these duties, C4s are supposed to promote the integration of city agencies, primarily by gathering critical information about the equipment available to urban teams and their specific ways of work; developing processes on how exactly these agencies should act collaboratively and apply its resources; and facilitating data integration and creation of tech tools capable of improving city monitoring and field operations.

On the basis of Rio de Janeiro's experience with hosting large-scale events, such as the annual carnival street parades, the Olympics, and the World Cup, it has been observed that the benefits provided by C4 start even before the operational phase of the events. The city's main C4 facility is the Rio de Janeiro Operations Center (or Centro de Operações Rio—COR, from the Portuguese abbreviation), and it has a key role not just in the real-time operations for events but also during the events' planning stage, supporting integration of agencies' plans and identification of potential risks.

To gain a better idea about how this operational integration provided by Rio's C4 works, it is useful to refer to an organizational scheme often utilized by the city's C4 team in institutional presentations—the so-called bicycle organogram, which compares the city to a bike and the urban operational agencies to the bike's chain wheel. As these agencies are entirely responsible for the hard operations that ensure a city's functioning, such as transportation and waste and sewage management, the chain ring is the key element that keeps the bike moving forward. On any given day, a city runs in a standard way, comparable to a bike running at a usual pace with its chain ring configured in a regular manner. When an emergency situation or an event requires faster operational functioning from the agencies, this can be likened to a bike that needs to move faster due

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to an external condition, requiring a new configuration for the chain ring to enable greater velocity. In this analogy, the gear control placed in the rear wheel dictates the different gears or configurations of the chain ring, consequently enabling the required bike speed—standard or fast. In the context of Rio, the C4 is compared to gear control, acting as a tool capable of changing urban agencies' configuration to achieve the required operational pace for a city according to the challenges to be managed.

The operational challenges encountered in organizing big events in cities include ensuring adequate transportation for people, managing the flow of crowds, and providing adequate security measures to prevent disruptions and mitigate the risks of emergencies. Nowadays big events become a big challenge for the city operations changing all the city flow in different ways and dimensions, requiring innovative technologies. According to Mehrotra and Lobo (2020), technologies such as command and control rooms enhance the overall event experience.

In addition to these elements related to the event itself, cities must also consider the impacts on the lives and daily routines of residents not attending the event. Despite meticulous planning, unexpected emergencies can still arise during large events, such as crowd control issues and security threats. These incidents require prompt and effective responses from organizers, emergency services, and other specific city teams, depending on the nature of the problem at hand.

For example, as city agencies organize temporary operational and leadership arrangements for specific events, it is C4's responsibility to understand the different work processes involved and enable teams to work together by integrating them into a more comprehensive joint operation unit. Unlike a regular day in a city, on event days, different types of problems may arise that eventually demand different operational peers to be contacted to act in the field or even temporary superior event leaderships to be engaged in executing top-down measures. In this sense, in the case of Rio, C4 structures also play the role of facilitating temporary communication plans for events in the city, allowing the timely engagement of right professionals to execute specific action protocols for events.

When a city fails to offer high-level service integration and centralized coordination between city agencies, lack of collaboration among different local teams involved in event management can lead to confusion and inefficiencies. Ultimately, this can affect the success of the event and even pose obstacles to organizing a series of events in the future. The common resulting problems that may occur in this scenario include transportation bottlenecks, poor response time for emergencies, and increased safety risks.

In this context the chapter was opted to this research question: *How does the COR utilize technologies and other specific approaches to enhance urban efficiency in preparation and operation for events?* To serve as the city's operational gear control, Rio's C4 has four primary departments: the planning sector, responsible for preparing for future operations to ensure their smooth execution; the operational coordination department, which manages real-time operations; the technology department, which provides tech tools to support the planning and operations teams; and the communication team, in charge of the communication channels focused on the residents and visitors (the city's "end-users"). If this system is not running properly, reflected in the need for the city (or the bike) to perform faster, it can lead to delays in joint-response actions, similar to the ring chain getting jammed, which causes the bike (or the city) to lose performance. Based on this explanation, COR's team uses this "bicycle organogram," as illustrated below (Fig. 11.1).

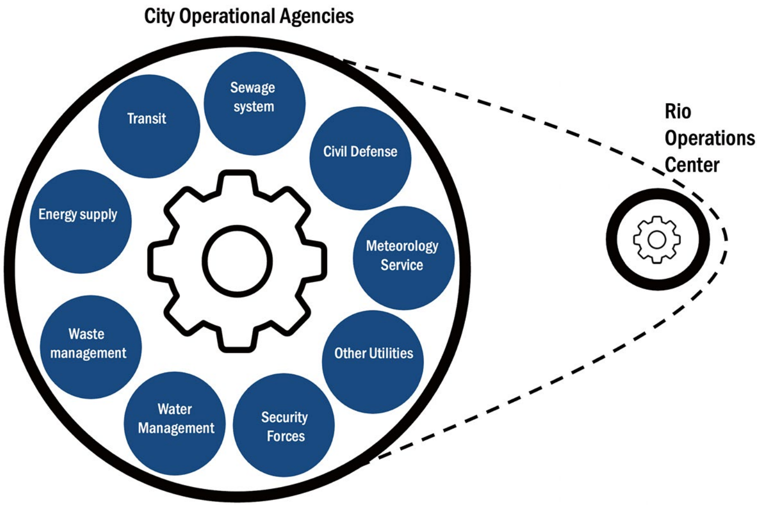

Fig. 11.1 COR's "Bicycle Organogram." *Source:* Authors (2023)

The present chapter fills a critical gap in literature by providing a comprehensive analysis of C4s and their potential to enhance event management in urban spaces. Furthermore, it introduces practical learnings and insights that might serve as a reference for other cities worldwide that wish to enhance their strategy to achieve excellence in event organization.

Command and Control: A Historical Background

To understand better the concept of command and control and their connections with the events, we need to understand first the relation between security and military defense. Throughout human history, mankind has intricately woven technological advancements into the fabric of warfare, a concept Virilio (1993) aptly termed the war machine. From ancient times, military institutions have spearheaded numerous technological and scientific breakthroughs, considering a multitude of factors. Deleuze and Guatarri (1986) assert that the war machine pioneers speed as a weapon, reshaping societal and political landscapes with its velocity. The author introduced the term war machine at their book called *Nomadology: The War Machine*, there they make all historical background since the beginning of the society to explain that the relation between the state and the war, as they can explain better: "As for the war machine in itself, it seems to be irreducible to the State apparatus, to be outside its sovereignty and prior to its law: it comes from elsewhere" (Deleuze & Guattari, 1986, p. 4).

War itself becomes a spectacle, where fear serves as the weapon. Emerging military advancements, prior to their role as tools of destruction, function as instruments of perception. In essence, no military discovery exists without intricate psychological manipulation (Virilio, 1993). Virilio (1993) debates in his book *Administration of Fear*, where he is interviewed by Bertrand Richard, and after a long talk, Virilio (2012) ends the book with the conclusion that the fear is used by who has the power to create the illusion that does not kill but enclosure.

The war started to be fed by the combination of State–Power–Fear. The first major war of contemporary society unfolded in European countries, which vied for power and territory, especially in Africa. In the Second World War, the focus shifted toward the militarization of everyday life, including the introduction of the concept of command and control.

The initial headquarters of command and control was London, where the American President Roosevelt allied with British Prime Minister Churchill to halt the Nazi advance across the continent. The planning of what became known as "D-Day" marked the first operation in which various military forces from different countries joined together to combat a common enemy, in this case, Nazi Germany. Command and Control (C2) was developed during this period, understood as a process through which commanders and managers wield authority and material and human resources to achieve a specific strategy (Ince, 1997). This concept could be military in nature or not, as it quickly became incorporated by large organizations in an attempt to minimize competition, viewed as an enemy to be defeated.

With the end of this conflict, the world entered a well-known confrontation, the Cold War. In it, the concept of C2 was expanded to Command, Control, and Communication (C3). Athans (1982) argues that even this evolution is not sufficient to keep pace with all the technological advancements of this era, and the inclusion of intelligence communication would be indispensable. Thus, the concept underwent another period of evolution, becoming known as Command, Control, Communication, and Intelligence (C3I).

With the discovery and spread of the internet, the capacity for surveillance of everyday life expanded significantly, capturing the interest of many powerful groups and private organizations. The concept of C2 underwent further evolution and came to be viewed as Command, Control, Communication, Computers, Intelligence, Surveillance, and Reconnaissance (C4IRS) (Pfohl, 2008).

Batista (2012) argues that the modern world is becoming increasingly complex, and technologies are gaining more and more space in the social and political context. A society focused on information and knowledge drives humans toward a constant quest for technological improvement.

Technological governance is the act of governing a technology so that it is used to its full potential, and one of the challenges of public administration, especially in Brazil, is to use this concept in a coherent manner. With states investing more and more in technological systems to control social flows, there is a growing need for improvement in technological governance.

In this context, the command and control focused on cities started to be more common where the public administration used the technological governance to enhance efficiency. Luque-Ayala and Marvin (2015) debate that the technologies started to be central for urban infrastructures around the world. The cities' command and control centers (C4s) become the headquarters of urban operation and infrastructure efficiency for the global cities (Sassen, 2001) where the technologies play the central role. We can find C4s in a lot of global cities around the world (e.g: London, Tokyo, Paris, New York, Seoul, Rio de Janeiro, etc.), proving the importance of this topic.

They promise to improve the quality of urban services, to make the city more efficient and sustainable, and to automate the operation of urban infrastructures. Alongside these commercial innovations, municipal authorities are mobilizing resources toward the development and operationalization of a variety of digital platforms aimed at transforming both service delivery and infrastructures. (Luque-Ayala & Marvin, 2020)

Based on this background, the chapter aims to detail how Rio de Janeiro uses its main C4 facility to serve as one of the coordination pillars of events planning and operations, which has been put to test in hundreds of medium- and large-scale events hosted in the city from 2011 onward. By providing an integrated planning process and real-time updates on event-related schemes, operational restrictions, and potential emergencies, COR—Rio's municipality C4—made direct contributions to improving the overall experience of event attendees and minimizing disruptions to the wider public. To detail this positive impact, the COR will be assessed through a broader approach, considering its singularities and interventions within an interorganizational framework rather than just focusing on command and control as a technological solution.

Methodology

This chapter is qualitative research with the Participation-Observation (PO) as a method. PO emerges as a method used mostly by qualitative studies where the researcher immerses himself into the research problem, in this case at COR (Welch and Saville-Troike, 1991). This methodology involves observation as "the systematic description of events, behaviors and artifacts in the social setting chosen for study." Observations allow the researcher to describe existing situations using the five senses to provide a "written picture" of the situation under study (Kawulich, 2005). PO plays an important role because they can see from inside of the research objective the true relationships and functionalities. The participant observation method allows going far beyond the superficial description of a situation, thereby facilitating the identification of the meaning, orientation, and dynamics of each moment, component, and decision. For this reason, this method promotes an intense interaction between the researcher and the researched object (Da Conceição and Correia, 2009).

Still, Da Conceição and Correia (2009) argued that it is essential for the observer to be aware of cultural stereotypes and develop their capacity for introspection. It is a tool that all researchers use to understand new situations, such that they are able to understand the meaning of the actions and interactions of the actors within a group of participants in the given context of a study.

In this context, Creswell (2015) developed during his deep study about methodology some steps for a good observation, which this chapter follows closely.

– Step 1: select a research side.

The Rio de Janeiro Operations Center was selected for study, as one of the authors had been an integral part of its management team from 2011 to 2021, actively involved on a daily basis over the span of a decade.

– Step 2: Develop an observation protocol.

Over the years, the authors developed a detailed protocol of observation. Furthermore, the authors have collaborated on numerous publications related to this topic in the past.

– Step 3: Focus on observation

For this chapter, the focus of the observation was the operation of the COR-Rio during a big event as a carnival which consists of approximately 500 simultaneous street parades in all city regions that mostly take place in just 12 days and the Rio 2016 Olympic Games.

– Step 4 Determine your role

Creswell (2015) argues that there are four main roles for a PO, and this chapter chooses the complete participation, where one of the authors plays an important role inside of the COR being part of event organizations, planning, and management. Having a broad view about all operations that involve big events in Rio de Janeiro—Brazil.

– Step 5 Record field notes

As the COR is a public institution, the record of all information relative to the events needs to follow the Brazilian privacy law, that included a lot of restrictions for the authors. With this in mind, the authors make written notes that can't include sensible information about the public operations. Creswell (2015) argues that in some PO cases the researchers need to deal with some challenges and adjustments; in the case of this chapter, the record field needs to be meticulously thought out so as not to break the Brazilian law.

C4 and Rio de Janeiro's Approach to C4

Cities represent a complex amalgamation of resources, strategies, and actions influenced by political, economic, climatic, and physical factors, engendering urban challenges necessitating meticulous planning and enhanced management approaches (Lemos, 2007). Embracing information and communication technologies (ICT) emerges as a pertinent avenue to confront these challenges, augmenting information dissemination within urban landscapes and facilitating informed decision-making for societal benefit (Goodspeed, 2014).

As asserted by Bettencourt (2014), cities serve as significant generators and consumers of data, with the proliferation, capture, and organization of data catalyzing the evolution of urban systems via interactions among citizens, the private sector, and governmental bodies. This influx of information not only improves urban utilization but also bolsters proactive measures against potential urban issues (Harrison & Donnelly, 2011).

Within this framework, the utilization of ICTs for data generation can significantly bolster urban management efforts, mitigating inefficiencies within existing urban frameworks. Leveraging diverse data sources such as sensors, cameras, mobile devices, and social media enables rapid problem identification and response, thereby amplifying the efficacy of public service operations. Moreover, these data reservoirs not only ameliorate the impact of current issues but also inform future planning endeavors, fostering dynamic urban environments and encouraging citizen engagement (Steenbruggen et al., 2015).

As a tool to enable integration of ICTs in urban management, the C4s, also known as city operations centers, are centralized facilities aimed at managing and monitoring diverse city services and operations in an integrated manner. They gather real-time data from multiple sources, including traffic cameras, sensors, emergency services, and other city agencies, to facilitate decision-making and coordinated responses to different situations. The primary purpose of these centers is to enhance situational awareness and the quality of city services, thus ensuring the safety and security of residents. They are put in force in different cities worldwide to manage emergencies, oversee city services and infrastructure, facilitate city planning and development, and enable risk management. C4 can manage various functions, including traffic management, public safety, emergency response, utilities supervision, and environmental monitoring. These centralized and integrated management structures in the form of a government agency can assist decision-makers in a more coordinated, systemic, strategic, and data-driven manner (Muse et al., 2020).

In the context of smart cities, information and communication technologies (ICT) have played a vital role in the evolution of C4 (Hojda et al., 2019). These centers have evolved from simple dispatch facilities into sophisticated data-driven facilities that rely on advanced technologies such as sensors, cameras, and artificial intelligence. The integration of technology into C4s has enabled these facilities to collect, process, and analyze vast amounts of data in real time, providing city managers with a comprehensive view of their city's operations and performance. Consequently, it opened doors to improvements and optimizations in city's situational awareness, emergency response capabilities, resource allocation, and coordination of services. The employment of technology in C4s is a key element of smart city development and is essential for cities to achieve their goal of creating more efficient, resilient, and livable urban environments.

Different cities have different approaches to their respective C4 architectures. While control centers are dedicated to managing distinct complex infrastructure operations such as energy and water supply, other C4 structures, especially those focused on emergency response and public security, promote integration of many city services to provide quick responses to urban emergencies as well as issues related to criminal activities and public disorders. In 2010, Rio de Janeiro came up with an even broader range of services within the purview of Rio Operations Center, encompassing more than 30 services in a control room that operates 24 hours a day. The criteria that has been adopted in Rio since then is that every service, whether public or privately owned, involved in the city infrastructure, logistics, and emergency operations of the city should be integrated with the COR (Fig. 11.2).

The operational concept of COR had many influencing factors. One of the original factors was the municipality's experience with its first command-and-control structure (a simple control room connected with field teams through mobile phones and radio communication), temporarily implemented for the 2007 Rio's Pan-American Games. Subsequently, in 2010, after a damaging heavy rain situation, the municipality asked IBM to conceptualize a new city operational center, based on a more technological approach and the company's previous experiences in New York and Madrid, resulting in the COR's building structure design. As COR started its operations in 2011 with a heightened focus on emergencies, it was also influenced by the civil defense incident treatment approach, adopting especially the same practices utilized in the airline industry for handling disasters, as a significant portion of its operational coordinators came from this sector. Furthermore, during its daily operation, due to the expanded construction works the city was facing in preparation for 2016 Olympic Games, COR needed to play the role of an urban mobility coordination hub, which included engaging in direct communication with citizens, keeping them well informed about transit

Fig. 11.2 Rio de Janeiro operation center's control room. *Source:* Author's personal archive (2016)

impacts caused by works in progress. These factors forged Rio's command-and-control operational model.

One of the primary goals of COR at that time was to improve the management of crises related to heavy rain events, which historically occurs more often during summertime, claiming the lives of dozens of citizens per year. Other relevant objective, as mentioned, was to cope with the impacts of large-scale city interventions. To achieve these goals, a higher level of integration in urban operations was required, and COR managers negotiated agreements with related urban service teams, with the direct sponsorship of the city mayor. The aim was to integrate data, communication channels, and teams. From 2011 to 2023, these agreements evolved to include integration of processes, operational protocols, and planning procedures, positioning COR as the main facilitator and communication hub for urban operational services.

Rio de Janeiro has as a strong tradition of hosting events—it is normal for the city to host, for example, 10 events in a regular month, each

Fig. 11.3 The image illustrates one of the last integrated planning sessions before the beginning of Rio 2016 Olympic Games, which took place within COR. *Source:* Author's personal archive (2016)

drawing between 2000 and 20,000 people. The extensive planning and operation efforts required for hosting events such as the 2014 World Cup, the 2016 Olympic Games, and the annual carnival parades have played a major role in improving COR's approach to integration. This occurred because the complexity of these events forced city teams to learn to operate together. Failing to do so could have potentially turned all the big events, especially the carnival and the Olympic Games, into a nightmare scenario, putting thousands of people at risk. Following each big event, as Rio's C4 was already in continuous operation, the efforts to enhance integration for these events had a lasting impact on city's daily operations. This legacy resulted in more smooth integrated processes for the city teams. As a result of this repetitive process, COR progressively gained recognition as the primary city coordination equipment, as detailed in the following section (Fig. 11.3).

The Rio de Janeiro Operations Center and Its Main Functionalities

One of the largest cities in Brazil, Rio faces a complex urban dynamic with over six million inhabitants, challenging geographical features, and a significant social gap. To manage these challenges, the City Hall of Rio de Janeiro implemented the COR in the December of 2010. COR is a C4, originally attached to Rio's mayor office, designed to facilitate the daily operations of the different systems and infrastructures that constitute the dynamics of the city, plan and integrate operations for major events, and manage emergency situations.

COR has technological systems at its disposal and operates in direct collaboration with a wide range of city services, such as the traffic and public transportation management, public cleaning, water and energy supply, public maintenance, the local meteorological team, and the police force, to name a few. In addition, it integrates data from various city agencies. Rio's C4 receives real-time data from various sources, including sensors positioned across the city in locations such as meteorological stations and bus networks; street flood sensors; private partners such as Waze and Moovit apps; and images from more than 2000 cameras. The center works continuously with the aim of anticipating problems and coordinating integrated solutions. It communicates simultaneously with the primary competent bodies for immediate action whenever any issue occurs. The alerts generated by the smart sensor-based systems implemented in this structure also serve to support city managers in decision-making, enabling them to deal with urban occurrences and emergencies.

Rio's city managers wanted to place COR in the position to properly respond to expected and unexpected occurrences, with the aim of minimizing impacts caused by any issues in the citizen's daily routine. To achieve this, COR was equipped to perform three primary activities to play its role in the urban space: identifying city's problems at whatever stage they are; integrating responses and services related to problem-solving and other operational needs; and keeping city teams and citizens informed about what is going on in the city, which might necessitate response actions.

In the following, how COR's managers addressed these three main responsibilities will be discussed, in addition to the results achieved.

First, to identify city problems, COR gathered visual data from all existing city sensors and cameras and linked the city team's communication channels to its control room. This was complemented by the assignment of city agencies' representatives in the same room who worked together on a daily basis. Both measures may appear obvious now. However, historically, Rio's operational services used to act in silos; hence, connecting these services and their monitoring tools in the same open space marked a significant step toward building a new culture that relied

Fig. 11.4 City agencies' operators working together in the same control room in 2023. Marked in red are software showing the ongoing problems in the city and data from street sensors, providing real-time monitoring for all professionals. *Source:* Author's personal archive (2023)

on a continuously integrated structure for city management. Instead of the previous peer-to-peer integration, Rio switched to a multi-peer work platform, enabling stakeholder to quickly acknowledge issue alerts (Fig. 11.4).

Earlier, one team would notice an issue through monitoring and call, one by one, other city services (usually in different locations and without establishing a clear liaison contact to facilitate integration) to engage in a complex response to the problem. After COR's roll out, issues were noticed and instantly shared with liaison officers from all agencies in the control room, decisions toward prompt response were jointly taken, and each peer engaged specific resources of its team to perform field activities. The new coordination framework facilitated risk anticipation and problem identification, in addition to upgrading the level of coordination in field joint operations. As this process was repeated several times a day, soon, the teams started to come up with ideas to enhance it by developing new monitoring tools and even implementing specific operational adjustments.

The second role is regarding response integration. COR's effort to achieve it created the necessary conditions to enable more efficient and optimized collaboration among teams for city operational management and field activities. Once a problem is detected, city teams need to make quick decisions to address the emerging needs in the response process by taking into account the following:

- Which resources should be engaged?
- Who is responsible for following executed activities by multiple players in the field?
- Which agency will provide information on the time needed to solve a problem and, as a consequence, the impacts that the city will have to address?
- In a multi-team response situation, who knows in real time the status of the tasks performed by each agency?
- Who will raise the flag, indicating the need for more resources or complementary contingency efforts to solve an issue?
- Informing other interested parties and the media about the problem, the responses in effect, and the consequent impacts.

Typically, each department is responsible for its own activities, and none of them are entirely concerned about real-time overseeing of the whole operation to solve an urban problem. The above-mentioned swift decision-making and the integration role, in the case of Rio, were readily embraced by COR's multi-agency team. The C4 needs to address any problem that arises—always looking for the quickest and most optimized solutions. Issues such as traffic accidents in rush hours, gas leakage in open areas, or an unexpected public work intervention with significant impacts are identified in less than five minutes, and all first response services are engaged straight from the control room. In addition to this, every problem with the potential to exert at least medium-level impact on the city is closely overseen by COR, enabling the city to swiftly take additional actions as any new obstacles are detected.

The third role played by Rio's C4 is to serve as the primary source of correct information about the status of city's infrastructure, logistics, and emergency operations. This responsibility can be split into two different audiences, namely, the city's operational teams and the citizens in general, with different communications channels utilized for each. On the one hand, there are the urban agency operators, the ones in charge of monitoring and executing direct operational tasks to solve problems. While they execute activities in the field or monitor an issue, COR provides them with real-time updates about the problem-solving efforts and the status of the consequent impacts caused (or the ones that can potentially be caused). This continuous communication flow keeps teams updated about the progress of all aspects related to specific operations. On the other hand, the C4 shoulders the responsibility of keeping citizens informed about what is going on in the city that may affect their routine, along with providing clear messages containing information on recommended behaviors and the decisions taken (Fig. 11.5).

To stablish easily comprehensible communication with citizens, two main actions were taken by COR's team. The first was the establishment

Fig. 11.5 Advertisement boards of the street digital clocks are one of the communication channels of COR. In the illustration, the board informs the traffic conditions of specific routes. *Source:* Author's personal archive (2017)

of direct communication channels between citizens and Rio's control room by using social media platforms and inviting local news broadcasters to position liaison journalists within COR. The second was to define new and simple patterns of messages for the releasing of city reports. For example, as a part of the messaging simplification effort, the C4 adjusted and presented to people four-graded weather severity alerts, which were previously used only internally by operations teams. The four different stages ranged from "normality" to "crisis," informing people via simple expressions if the city was dealing with a high level of operational restrictions and the risks involved. In addition, the reports also included clear recommendations for citizens for minimizing impacts on their daily lives or even keeping themselves safe. This type of information started being released in reports three times per day, with other details such as air quality and public transportation disruptions. COR also provided real-time coverage of city's operational conditions over social media platforms such as Twitter and Instagram and through local news media channels. Social media followers also grew accustomed to reporting emergencies they saw in the streets, and, often, the first information about high impact occurrences came from Twitter—the channel with the highest real-time interaction with citizens.

From Managing City's Daily Routine to Handling Big Events' Operations

Whenever a problem is detected in Rio's daily routine, COR's team facilitates the engagement of services needed to resolve it. The more complex and diverse the need of specific services for responding to an issue, the higher is the magnitude of COR's contribution to execute the required response actions. In a practical manner, while each agency dived on the basis of its own operations, COR's professionals serve as the integration link between different teams, following activities as they unfold. Furthermore, the more impactful an occurrence could be for the city and citizens, the higher is the intensity of the communication activities led by the C4, informing field teams and people about the status of the issue and the actions required.

To manage programmed events such as open-air sporting competitions and big concerts, the complexity of COR's work increased. Events draw hundreds or even thousands of people to venues, commonly affecting city operations. This leads to a high volume of commuters concentrating in public transportation at the same time, causing traffic congestions that sometimes require street closures or other special operational efforts to minimize impacts on urban logistics and infrastructure. In such situations, the city's teams have to respond in different conditions, usually in a shorter period of time, as risks and small problems can worsen faster because of the high volume of people. These different ground conditions imply the need for specific operational planning for organizing how teams will be integrated in the field, assessing main risks, and establishing specific resource allocation and contingency plans. As an integration facility, Rio's C4 progressively engages in event planning sessions, also acting as a planning hub for the agencies involved.

Therefore, since 2011, Rio's city teams and event organizers started to use COR, not just as the operational headquarter but also as the planning headquarter for programmed events. The first step in event organization, especially if the event is an open-air one, is to obtain the City Hall license. Once the bureaucratic groundwork is in place, organizers need to start the planning process in collaboration with city teams, which takes place as follows:

- First, organizers (usually private companies) present the initial version of the entire plan for the event to city teams' planning representatives.
- City teams analyze the event's initial plan and highlight any restrictions that need to be taken into account for adjustments such as replacement of hotspots for the event's operations or the need for street closures or positioning of special equipment to facilitate street crossing for attendees.
- Event organizers and city representatives negotiate a final version of the event plan, covering risk assessments and contingencies, for

instance, the necessity to position support teams to increase people flow in a specific risky spot.
– A final plan is agreed upon by the involved teams and, since the event-specific operation might affect city's daily routine (such as higher demand at a critical transport station or temporary street closures), its details are communicated to citizens through press conferences or press releases and reports, depending on the size of the event.

As COR increased its relevance in city operations, its managers strategically arranged for most of the planning process and discussions to be held within COR meeting rooms. With this move, the C4 team started to gain access to valuable information that allowed them to monitor the ongoing operations and provide better support for responding to problem occurrences in different scenarios compared with the city's standard response process. As this process evolved, COR professionals started to progressively play the role of planning facilitators and began providing better support with risk assessment sessions for events in specific regions such as the Maracanã soccer stadium and other parts of the city where events typically took place.

Rio's C4 and the Season of Street Carnival Parades

The season of annual street carnival parades is perceived by Rio's city teams as one of the most complex operations to manage. In the first quarter of each year, within 12 days, 500–600 street parades take place simultaneously in different city regions. According to the official figures presented in Statista data research, these parades draw more than 7 million people (of which almost 2 million are tourists) (Statista, 2023). The high variation in the number of parades is due to the unofficial parades that are not authorized by authorities. These unofficial parades attract thousands of people as a "cool" trend and a peaceful form of protest that has emerged in the city in the last 15 years in response to the City Hall trying to control the yearly increase in street parades.

The complexity of the carnival season can be easily compared with that of the Rio 2016 Olympic Games, when dozens of sports championships took place simultaneously in many city regions, gathering thousands of people commuting to and from the venues. The carnival even adds some extra elements, as the parades transform the whole city into an open-air venue, with higher levels of alcohol consumption compared with the Olympics and the subway system open for 24 hours without interruptions. Thus, Rio de Janeiro's carnival is essentially an operational marathon that places significant demand on city teams and resource management officials in a short period of time (Fig. 11.6).

The main challenge encountered during the carnival period is making the city run in the best way possible for the event's participants, while minimizing the impacts for residents who are not attending the event. In this sense, COR has to almost coordinate operations for two different cities within the same territory. The preparations for carnival season involve operational planning negotiations with event organizers, as described before in this chapter, with three primary goals: to agree about the timings and itineraries of each parade; to define city agencies' resource

Fig. 11.6 In 2017, through one of the city cameras, COR's team monitored a heavy rain event during a street carnival parade in Ipanema region (screenshot from the camera). *Source:* Author's personal archive (2017)

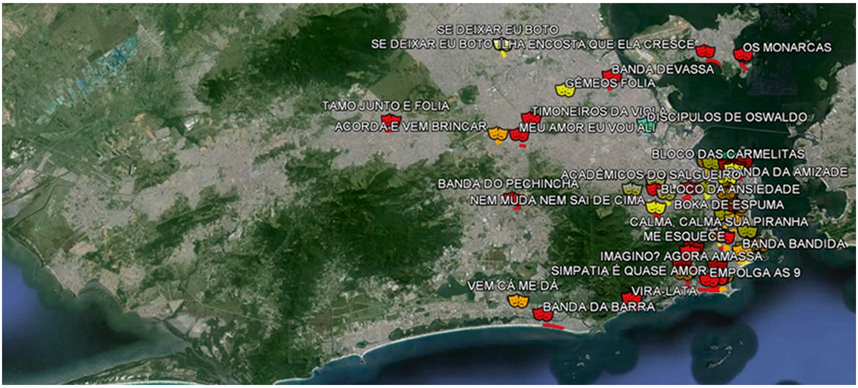

Fig. 11.7 Image shows the distribution of street parades in just one day of the 2016 carnival season in a planning map. Each icon represents different parades with its names highlighted. This map was one of the planning tools used during COR's planning sessions for the event. *Source:* Author's personal archive (2016)

allocation in the different regions of the city; and to assess risks and define contingencies. As COR started its operations in 2011, it has managed 13 carnival seasons and hundreds of other big events, resulting in the learning of valuable lessons that have evolved into best practices for improved management of city operations. In the following section, these adjustments applied in Rio will be detailed as measures adopted to enhance the operational and planning processes for big events, encompassing problem identification, services integration, and communication strategies targeting field teams, residents, and tourists (Fig. 11.7).

C4 as a Hub for Big Events' Operational Planning

As mentioned previously, it is important to break down one of the first relevant measures adopted by COR, which was to progressively get involved in events' planning sessions. The C4 team was forced to do so because a significant portion of relevant information regarding events' organization and planning was isolated in silos, which exacerbated the challenge of solving complex problems during operations. However, since this level of involvement was not a common practice before 2011, COR faced an initial challenge in determining how to enter the planning process with a clear role, provide meaningful contribution, and overcome resistance from city agencies.

The way COR approached this challenge was by positioning itself as a service provider to stakeholders involved in event organization within the city, rather than attempting to abruptly lead planning sessions, even though it had the authority to do so. First, some basic efforts were made to provide a good work environment for planning sessions, such as providing comfortable meeting rooms with coffee, snacks, and professionals available to note the minutes of discussions. After the meetings, COR's planning team undertook responsibilities such as mailing the meeting minutes to participants and maintaining contact with them between meetings to ensure that pending issues were addressed and the planning discussions proceeded efficiently. This approach may appear a little bit juvenile; however, starting from these simple tasks, COR shortly assumed the role of the primary planning facilitator, responsible for setting meeting agendas, intervening in negotiations to build consensus on topics where agencies had diverging opinions, and acting as a guarantor of the operational planning agreements reached in event preparation sessions.

This was the path taken by COR to go from being a simple service provider to a recognized planning facilitator for big events. This role was not officially designated, but the C4's team identified it as a strategic position to be cemented. Furthermore, COR had the support of the City Mayor's office to play its role in the overall operational management of the city. However, on a daily basis, this top-down endorsement was complemented with bottom-up relationship building with agencies' leaders, avoiding an authoritative approach to build confidence and partnership with event organization stakeholders. As a result, operational information that was isolated in silos before became accessible to the COR team, and they shared it in a more effective manner among all city teams through technical reports and other materials. This information included details on operational activities' milestones, mapped risks, and other planning content. These documents supported real-time operations within COR's control room.

Carnival after carnival, event after event, COR followed the same planning processes, consolidating its key role as facilitator. By performing these processes repeatedly, in addition to fostering a new organizational culture for event planning, Rio's C4 built a knowledge base, establishing new standards for planning sessions' leadership, reference documents and reports, risk assessment, and data products for supporting planning such as planning dashboards. In a few years, COR had mapped all expected primary inputs and outcomes necessary to support the management of the yearly carnival season and other big events.

Problem and Risk Identification

One of the most critical outcomes facilitated by COR's carnival knowledge base was more efficient risk assessment. Problems and risks mapped in the past were organized into reports to be revisited in debriefing sessions and in the coming years' planning meetings. COR assumed the responsibility of documenting these events' experiences and ensuring that agencies could plan new operational measures to better manage these events in the future.

From planning sessions for the carnival season to the Rio 2016 Olympic Games, Rio's C4 took a step forward in risk assessment for big events by incorporating simulation exercises to the process. As a common planning practice for the International Olympic Committee, COR's team learned the skills to conduct different kinds of simulations involving multi-authority professionals. It appeared as an effective practice for a C4, enabling it to identify gaps in operational responses protocols. With the gaps mapped in tabletop exercises, COR produced materials for agencies to equip them to build enhanced contingencies when needed. The most critical contingency plans involved teams conducting multi-agency field inspections and participating in real-life simulations as training sessions for its operational implementation in the field of action. COR's role in this context primarily involved studying and documenting risks for a better understanding, engaging stakeholders to address these risks through simulation exercises, and supporting this agenda as a facilitator of integration among various parties involved. A main lesson learned from the execution of simulation exercises was that it could be utilized to

Fig. 11.8 Professionals engaged in the urban mobility operations of the Rio 2016 Olympic Games, gathered in a scenario simulation session within COR. *Source:* Author's personal archive (2016)

promote the engagement of a wide range of stakeholders from different spheres of the public sector (Fig. 11.8).

Another meaningful role played by COR was to search, develop, and implement new technological tools for real-time risk and problem identification. In addition to software for monitoring social media posts for any issues reported by Internet users, below are a few other examples of tools that have been tested or implemented by COR, during carnival seasons and other major events in the city.

Tools for remotely monitoring specific routes: critical routes to events are monitored in real-time by utilizing Waze app and Google Maps data. COR's development team designed the tool that is displayed in the control room's videowall.

Use of mobile data to learn about people's commuting behavior: COR entered into a partnership with a global telecommunication company and employed CDR-anonymized mobile data of people to track mass commuting behavior during the carnival season. The same tool also provides an understanding of where tourists are most concentrated in the city by accessing mobile area codes.

Artificial intelligence tools to quantify gatherings: Through joint collaborations with universities and start-ups, COR implemented different tools that applied artificial intelligence features to analyze images from cameras and estimate the quantity of people.

These solutions primarily rely on sensor-based data and Internet of things infrastructure. With the integration of new technologies related to artificial intelligence, these solutions have the potential to evolve to even higher levels of effectiveness, especially for risk assessment and anticipation of potential issues. COR is already involved in other experimental projects based on artificial intelligence, using different city data sources. However, there are barriers to be overcome, as these technological innovations need continuous investments in research and development and acquisition of market solutions, which is still not a solid reality for almost any Latin American local governments. However, to facilitate this technological evolution, Rio's C4 is investing in its own open innovation program and establishing fund-raising partnerships with private companies and financial institutions.

Integration of Services and Operations for Big Events

In any given day, COR's control room have liaison officers from main operational agencies involved in the city's daily operations to respond to standard urban problems in an integrated manner. Depending on the severity of the issue, these officers escalate it to higher-level managers, aiming for an acceleration of response timing. However, during the carnival season, as the venue is the city itself as well as thousands of people can get immediately affected by an issue, any problem or risk identified needs quicker response time compared with a regular day.

To achieve this, many agencies engaged in the parades' operations, such as civil guard, cleaning services, and legal commercialization supervisors, are requested to position one extra officer with high decision-making faculties within COR. This second level of representatives are positioned in a second room, which is akin to a “war room,” where they execute their responsibility to cover specific needs for carnival operations. As events’ dedicated liaison officers, they have knowledge about how their teams are organized in the field and, consequently, are aware of the exact professional that must be engaged to solve an issue in any of the city regions. Despite this being a common practice for C4s, it can be worthwhile to share details on how it is executed in Rio’s case, with the addition of certain lessons learned in the 2016 Olympic Games.

Within this separate work room for superior decision-makers, the main operational milestones are followed, such as the start and end time of each parade, through real-time tracking software. This information is then communicated to teams, as will be explained later in this chapter. Often, event organizers extend the duration of their parades, and field teams are engaged to make them follow the planned schedule. All critical issues pertaining to the carnival must be addressed in this “war room,” while the regular control room takes care of predictable impacts of the events, such as planned street closures and its effects on traffic and other regular problems encountered in the city. Both rooms have their own coordinator (the city leader and that of the event) and are linked to ensure coordinated city management. This separate command-and-control arrangement has proven to be efficient in improving field time response times during street parades.

For the Rio 2016 Olympic Games—a more complex event with operations that were significantly more geographically spread and dozens of daily programmed events that needed to start on time to adhere to global broadcasting agreements—this arrangement went even more segmented. The COR control room was split in two parts: the first to take care of the standard operations in the city and the second to cover the Olympics. Each part had its own leader, and both leaders worked in coordination. The Games’ segment was divided into four operational clusters, each with its own teams, representing four city regions in which the Olympic events were taking place. Each team had dedicated liaison officers who collaborated with city agencies and event organizers. For the open-air competitions such as road cycling and marathon, a fifth temporary segment was installed in the control room just to coordinate them. This segment included a superior COR manager who ensured direct communication with city services' managers to facilitate quick response whenever needed. In a separate room, which was a requirement of the International Olympic Committee, a dedicated command-and-control center operated, overseeing all public transportation operations for the Games, including airports, buses, subway, trains, and all other commuting services.

Another significant measure learned from Rio's carnival seasons to enhance the integration of city services for big events is to have an event organization liaison officer within COR responsible for real-time operations. Rio's city tourism department has a relationship with all parade organizers. They have one seat at the carnival's "war room" to ensure COR has access to good quality information from the field. In one of the past seasons, a big tennis tournament, called Rio Open, was also organized during the carnival. Even though the championship was played in a private closed venue, given its proximity to many carnival events, especially those being held in bars and restaurants, the tournament organizers positioned a representative in the "war room." This was done to enable quick engagement of city teams to respond to any issues. Their primary concern was the possibility of unofficial street parades occurring around the venue, as the games could not be played in a noisy environment.

Communication with City Teams, Citizens, and Visitors

Ultimately, all the efforts of C4 are people-centered. Providing great conditions for people attending an event and minimizing the impacts of events on non-attendees' routine are all people-related challenges addressed by C4. In this sense, the individual behavior and decision-making of people play a key role in promoting city operations for a big event. Therefore, Rio's C4, since the start of its operations, has been deeply involved in providing clear and continuous messages to people, with the aim of helping them make better decisions to avoid risks, stay safe, and make a direct contribution toward city operations' smooth running. Without this effort, COR would become an information hub closed off to its own processes' purposes, failing to share information with its most important customer: the citizens, including residents and visitors.

To achieve this communication goal, COR managers took two pivotal decisions. The first was to provide timely messages by eliminating unnecessary layers of intermediation between the source of information and the target audience. COR has a communication team within its control room, feeding messages to people 24 hours per day. This measure involved prior arrangements with City Hall communication managers to establish a clear scope and standards for messages, as well as to consolidate an escalation plan for crisis management in terms of public and media relations. Despite the fact that it was not a trivial negotiation, it enabled COR to deliver outstanding service value to the city, as the numbers below indicate.

In 2023, COR's social media profiles has drawn more than 1.5 million followers. According to official figures, during days affected by significant operational crisis, such as heavy rain, COR's messages can reach 4 to 6 million social media timelines within 24 hours. Even considering that two profiles in different social media channels can be owned by the same person, there isn't any record of such high numbers for an emergency management facility in Latin America, and even in the whole American continent. As a comparison, the Twitter profile of the New York City Office of Emergency Management has 100,000 followers, while COR's profile has almost 800,000 followers. In 2012, COR's Twitter profile was a finalist in the government category of the Shorty Awards—the global recognition prize organized by the social media company, narrowly losing the award to NASA's profile.

The other significant decision was to position COR's messaging means strategically throughout the city to establish a ubiquitous communication pattern. Every channel that could improve COR's power of communication became a potential partner. Currently, in addition to social media platforms and local news broadcast channels, COR communicates through public transportation stations and vehicles, soccer stadium's videowalls, digital street clock poles, urban mobility apps such as Uber, Waze, and Moovit, soccer clubs' social media profiles, to name a few. The attempt of the COR communication team, although it was an unsuccessful one, to partner with Tinder dating app to communicate city alerts to its users is an example of the C4's ambition to increase the reach of its messaging. All these interventions are a product of the lessons learned in coping with the annual heavy rain seasons. During this time, an expanded communication scheme enables city managers to save more lives, irrespective of messaging medium used.

COR treats communication for big events with this same vision. For the carnival parades, which take place during the heavy rain season (summertime), tourism department liaison officers within COR enable the communication of safety recommendations through the parade's sound system as and when needed. This happened a few times when COR's meteorology team issued internal warnings about approaching heavy rain in the parade's region. The "war room," in collaboration with event organizers, advised a temporary pause in the event and recommended participants to find safer spots. These messages were subsequently relayed through the parade organizers' audio system.

Other examples of good practices in communication for events can also be cited. During the 2014 World Cup, the Maracanã soccer stadium displayed recommendations on its videowall pertaining to better ways for attendees to return home after a match by utilizing the special urban mobility schemes provided. In the 2016 Olympic Games, COR managed to send direct messages to ticket owners by using the official SMS messaging service of the event. In parallel, even before the events took place, Rio's C4 communication team kept releasing local press reports and social media posts for residents, detailing operational restrictions in the city and advising citizens on how to take decisions that would minimize the impacts of these restrictions on their routines.

Furthermore, COR is also responsible for making city teams and managers aware of city operational conditions and the main problems and risks at hand. These communication activities flow very naturally, through the communication channels that COR provides for city agencies, which enables quick information exchange and integration for decision-making during field actions. Rio's C4 plays the role to understanding each agency's particularities and unique communication methods, which enables it to "translate" information and ensure that all teams communicate using a common language and adhere to a shared operational standard. To achieve this, the COR's planning team has implemented two main measures. Initially, the team identifies the right contacts in each team that need to be linked to communication channels such as messaging apps, radio devices, and other tools. Then, during events, it is necessary to ensure the usability and pace of information sharing via these tools. This is achieved by messaging reports or even connecting individually with officers to keep the communication channels efficient and engage peers in the process. One relevant technological enhancement developed by COR and implemented in these channels are *chat bots*. With them, teams' managers and operators can easily access relevant information from the COR database, such as details of city issues under treatment or information on meteorological nowcast, via messaging apps such as Telegram and WhatsApp. They simply access the *chat bot* channel in one of the apps and select the information needed through a menu. The mobile apps are integrated with the C4 database, which is updated in real time.

Practicalities and Priorities

Beyond the lessons learned and the planning and operational arrangements underscored in this chapter on the basis of Rio's experience, there are practical obstacles that must be overcome to provide proper conditions to Rio's C4 to cement its position as the main facilitator of event organization. A majority of them can be attributed to difficulties in integrating city's agencies that are culturally accustomed to operating in silos. This prevalence of isolation mode has led to lack of information sharing and weak communication, which generates risky loose nodes in city operations. This makes it challenging for city teams to deliver integrated services to people, which, in turn, affects response timing and problem-solving performance.

In this context, Rio's C4 prioritized a few measures to position COR as capable of contributing to better integration in the planning and operations for organizing events in urban areas. For each of these priority measures presented, potential risks and obstacles noticed throughout COR's development path will be highlighted, along with how Rio managers addressed them.

"Command and Control Integration" Against "Command and Control Competition"

One common scenario often observed in cities, which also surfaced in Rio, is competition between different established C4s or even between city agencies willing to build its own centers. In Rio, this scenario unfolded a little differently because COR was the first C4 to be built, and since its inception, it acted as an integrator or a neutral space to be populated by representatives of city agencies. However, a few months after COR's roll out, regional police forces launched a bigger command center for security forces. This raised the question of how a city command and control strategy can be defined for events in a case like Rio, where two C4s are present.

Considering Rio's case as reference, the first vital step toward resolving this situation is by defining which C4 is better equipped to integrate a broader range of city services. In Rio, the police force's C4 is more focused on public security operations, while COR is more open to integrate all kinds of services involved in city operations. Other relevant aspect concerns communication service: Which C4 can take care of messaging service for citizens with regard to general urban operational restrictions and recommendations for people? In the case of Rio, since the police force deals with security and even confidential criminal issues, local media cannot be granted direct access to its control center. In case of COR, which primarily deals with non-confidential information concerning urban operations, local news broadcast partners have an exclusive room from which they follow the control room's routine and keep their audiences informed about what is happening in the city.

Analyzing these two perspectives, COR ended up as the main integration facility for events. However, both C4s collaborate closely, working with pre-aligned operational protocols to facilitate rapid interaction between them and engage the services required for effective problem-solving. Rather than competing, the two C4s value cooperation and exchange information and support each other. To this end, each C4 has a liaison officer in the other's control room, fostering daily integration that normally extends even further into the planning and operations of big events.

Integration with Event Organizers

After organizing hundreds of events in Rio, it emerged as a best practice for event organizations to have liaison officers working closely with C4. Without them, obtaining good quality information on ongoing operations can become difficult. For COR, this was not a straightforward task to accomplish it in the beginning. To attract organizers, event representative were offered the incentive of being able to easily engage city services from within COR's control room when needed, which could prove highly useful for them, especially during real-time operations. If there aren't officers available to be physically present at COR, communication is established with them using messaging mobile apps. In some cases, such as during the 2014 World Cup matches in Maracanã stadium, COR stationed one liaison professional within the venue's control center.

In this sense, it can be important to obtain high-level sponsorship from city managers, such as the Mayor's office, to establish mandatory rules for event organizers, thereby forcing them to commit to designating a liaison officer to operate from C4 during operations. This necessity varies according to the size and complexity of the event. However, it is a good practice to always enable C4 to message attendees via events' communication channels in case of any emergency situation.

Enhancing C4's Communication Capabilities

In Rio's C4 concept, all the information gathered within its control room does not have complete value for the city unless it is reasonably shared with the citizens. COR's approach to information exchange is as open as possible. In addition to the 24-hour information service through social media channels, the local media broadcasters have a dedicated press room attached to the control room, from which they can follow city's real-time operations whenever they want. According to COR's interactions with

C4s worldwide, this approach to communication is not common for two main reasons. First, it can lead to apparent competition with the main City Hall communication office, as the C4 would become the main source of truth in city operations. Second, implementation of a communication department within a C4 requires extra budget and human resources (Fig. 11.9).

Even though these two obstacles are not easy to address, it is worthwhile to add communication capabilities to a C4, as it was evidenced in Rio's case. This allows the C4 to be equipped with a faster and bilateral communication channel with citizens, creating a win-win collaboration. On the one hand, citizens gain access to fast and precise advice on urban problems and recommendations on how to address them. On the other hand, the C4 acquires thousands, or even millions, of eyes in the city as a new real-time source for identifying problems and risks. Another critical role that COR's communication team plays is the detection and treatment of fake social media content. When these pieces of news achieve

Fig. 11.9 Local news media professionals working within COR's press room in 2012. In the back of the image, this is possible to see the control room. *Source:* Author's personal archive (2012)

high-level impact and influence on the Internet, commonly, Rio's C4 posts messages flagging them as fake sources of information.

Conclusion: Building a Think Tank for Event's Planning and Operations

The COR case highlighted the relevance of providing a proper organizational, technological, and human resource structure to the C4 and positioning it as a facilitator in the planning and operations of big events. These experiences in Rio, broke down through the course of this chapter, underscores how the city positioned its C4 as a strategic equipment for event organization. As evidenced by Rio's case, reliance on C4 support not only provided better structure to events but also enhanced COR's planning capabilities by facilitating its involvement in the planning processes of big events over time. Beyond its capability to deal with urban emergencies and routine issues, Rio's C4 is also currently regarded as a city asset for operational planning when it comes to event organization, especially for open-air events that utilize the city as their venue.

Through active involvement in event organization, the city's C4 has built a knowledge base that has proven valuable for future events. This highlights the importance of the C4 maintaining records and archives of planning documents, operational strategies, issues that occurred, and identified risks. COR's planning team manages a comprehensive knowledge base about past events. This repository comprises wide-ranging content such as general descriptive documents, operational scheme maps, content discussed in sessions, and data that offers a 360-degree perspective, rather than being limited to a single agency's perspective. As events are repeated and evolve, or as specific areas of the city are designated to host specific type of events, this knowledge base becomes critical for improving future decision-making pertaining to event planning.

In the context of event operations, the main contributions discussed include C4's vital capability to communicate with three distinct target audiences: city teams, the general citizenry, and event attendees. In addition, the set-up of a "war room" within COR for annual carnival parades or establishment of a real-time link between event organizers and the local C4 are also best practices for improving collaboration between city services and ensuring even faster response times when needed. Another lesson learned from Rio's case is the significance of employing technology to facilitate risk monitoring during events, such as real-time data-based monitoring of relevant routes to effectively identify crowd gatherings and understand commuting patterns in the city during events.

This was the pathway followed by the Rio de Janeiro City Hall to equip its C4 facility to enhance the services it provides to the public, particularly for operations that can affect urban daily life. With this strategy, COR gained a better understanding of the requirements for different types of events, the kinds of problems that occur in each region, risk assessment specific to each venue, methods for effective communication, and the required actions to improve agencies' preparedness for specific events. Currently, there is no other facility in Rio that gathers so many city event experts and such a vast repository of event-related information. Each city has its own limitations, which need to be considered to assess the feasibility of implementing any of the best practices presented in this chapter. However, taking into account the Rio de Janeiro example, after hosting a few of the most complex urban events worldwide, such as the Olympic Games, the annual carnival parades, and the World Cup, these best practices strongly contributed for cementing COR's position as an event think tank for the city.

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12

Rio 2016: Case Study for Mega Events, Urban Mobility, and Flow of People

Simone Silva and Jacqueline Torres

Introduction

A significant portion of many cities' vitality can be attributed to their ability to host mega events, which can correspond to their size and capacity. These events can range from a single football match or a championship that can take several days to an important regional fair or music festivals. It is critical that city planners, in collaboration with specialists and/or academics, consider travel forecasts ahead of the event to provide a good user experience and, consequently, a successful event, ultimately resulting in a positive image of the host city. The purpose of this chapter is to outline the main steps of travel demand forecasting for mega events to help city planners, event organizers, and academics to collaborate for effective transit and traffic planning. This collaboration is crucial in

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serving the needs of spectators and minimizing the impacts on residents. The integration of the public transport system, pedestrian infrastructure, and roadway space are critical to the success and/or failure of mega events.

The process of travel forecasting, coupled with an accompanying strategy to address travel demand, enables event spectators to utilize modes of transport other than single-occupancy vehicles (SOV). The movement to and from mega event sites is one of the most critical components of the users' experience. For this reason, it is paramount to reasonably size, through demand estimation, the necessary supply of public transport. Equally important is to communicate the best options for public transport. This chapter will reveal the process of forecasting the demand to be placed on the public transport network during the Rio 2016 Olympic Games, while taking into account vaRious inputs. Some inputs were predefined while others were much more empirical, primarily based on information gathered from city and event experts, as well as previous events. It is important to highlight that this process is crucial and dictates the success or the failure of a mega event.

Can we consider the case study of Rio 2016 travel forecasting for other mega events? The answer is yes, because by examining the results and considering the planning aspects at both a macro and micro scale, it is possible to apply the insights gathered to similar events. This case study was considered because it is possible to gain knowledge from a complex subject (McCombes, 2023). The inputs and its characteristics are vital to observe and describe because the process used to develop travel forecasting from macro to micro scale in Rio can be applied to other contexts and in mega events of different sizes.

The Rio 2016 Olympic Games was a mega event that drew approximately 700,000 people per day, ranging from spectators to workforce staff, in a span of more than 2 weeks, going on for nearly 24 hours per day. This mega event relied heavily on the public transport network, which served not only the spectators and workforce but also more than half of the six million residents of the city who are completely dependent on the network for their transportation. Utilizing the Games as a catalyst, the city constructed a Bus Rapid Transit (BRT) network, consisting of three corridors, built one Light Rail Transit (LRT) line, and expanded the metro, connecting all four sporting clusters and closing major transport gaps. Part of these gaps involved adequate pedestrian infrastructure, an essential "last-mile" linkage important to passenger flow. Management of roadway by ensuring vehicular throughput and avoiding roadway paralysis was also vital to the movement of people and services. Passenger flow analysis was reliant on extrapolated demand, which was calculated utilizing the Four-Step Model (McNally, 2008). The model was applied to the Olympic Games Calendar, taking into account the pedestrian level of service, as outlined in the Highway Capacity Manual (HCM2010, 2010).

Also critical to the success of mega events is the efficiency of their operation and monitoring. During the Rio 2016 Olympic Games, 24-hour monitoring of the entire transport network, including both public transport and roadways, was performed.

Mega Events

Mega events are short-lived; however, their impacts are long-lasting, especially when considering their economic implications and the general image of the city. Furthermore, mega events exert significant impacts to the daily routine of the city, creating an additional demand with non-routine travel patterns that are difficult to plan and influence vaRious aspects of travel such as reliability, comfort, and travel time (Latoski et al., 2003).

Common among all mega events is the substantial flow of people to and from activity centers, whether they are areas that require entry by ticket, such as stadiums and arenas, or open public spaces, free and accessible by all. It is this substantial pedestrian flow and travel to all activity centers that are critical in defining the travel experience of those who attend or participate peripherally in these large events. To minimize negative impacts as a result of this increased pedestrian flow and effects on the transport system, it is essential to precisely estimate demand on the basis of available data that considers the volume of spectators, workforce staff, and others participating in the event for each day and hour as well as considers the origins and destinations of the commuters.

The success of mega events today is based on the principle that spectators and workforce should primarily rely on and use the public transport network to access event venues. In addition, limiting general traffic and parking in and around venue sites also contribute to the event's success. These are generally the same principles that guide the operational mobility plan of Olympic Games (Bovy, 2019).

One of the biggest challenges encountered in the planning and operation of mega events is accurately forecasting the required public transport supply to meet the considerably high demand, which is in addition to the regular daily urban demand. This exponentially increased demand can ultimately result in an oversaturation of the public transport network. In parallel to this increased demand, there is generally a reduction in roadway capacity by virtue of the event itself (Latoski et al., 2003). As a result, adequate planning concerning public transport and adoption of reasonable travel demand management strategies become even more crucial to the event's overall success.

Mobility Planning and Operation Monitoring

The central factor in estimating demand for any mega event is the number of people involved. A city must consider three groups of people: residents, spectators, and workforce staff. The second and equally critical element that needs to be taken into account when planning for a mega event is the movement of these three key groups. Planning mobility at the macro scale involves considering both of these foundational elements and providing a global expectation of the event's magnitude. The purpose of this section is to demonstrate the application of the Four-Step Model of Transport Planning in the Rio 2016 Olympic Games to estimate the expected mass flow.

In mega events, vaRious types of information are required, including data from both the host city and the local organizing committee. It is worth noting that certain data necessary for estimating demand are predetermined and relatively easy to obtain. Predetermined data, often shared by the local organizing committee, includes the event calendar and/or competition schedules, which provides information on expected start/end times, venue capacities, and expected ticket sales. Other predetermined data, such as those pertinent to the available public transport and roadways network, is often provided by the local city and/or public transport agencies. Other necessary data is more empirical in nature and is characterized by a higher degree of uncertainty, such as the origin of spectators, mode of transport that will be used, the exact arrival and departure times from competition venues or activity centers, and expected adherence to travel demand management policies. Understanding how all these data elements work together is not a straightforward process and one that directly influences the success or failure of a mega event. To facilitate decision-making process, several computer-based and manual tools have been developed.

Utilizing these considerations and information, it is necessary to develop studies based on the application of the traditional Four-Step Model of Transport Planning to the mega event's calendar (schedule of events) to offer adequate public transport and minimize impacts on the background or day-to-day city demands. Understanding the background demand movements is critical in assessing the impacts of additional demand exerted by a mega event. According to McNally (2008), the Four-Step Model includes the following:

1. Trip generation
2. Trip distribution
3. Mode choice
4. Trip allocation

As Maiolino et al. (2018) highlighted, the following inputs are essential to consider in the Four-Step Model:

(a) Knowledge of the calendar, with days and times of spectator movement to all venues and locations, specifically the critical peRiods of this movement. This information is provided by the event organizer.
(b) Knowledge of the capacity of all venues that are available or unavailable to the general public, provided by the event organizer.
(c) Estimated popularity of the different sessions of the event, assuming that some will attract more audiences. The popularity of event sessions varies by sport and the session type (i.e., general match, quarter, semi, or final match). For music or entertainment events, attendance

depends on the popularity of the artists and attendees' age groups. Once ticket sales data is made available, updates to this calculation can be made. Many sessions sell out months in advance. This input is provided by the event organizer.

(d) Temporal distribution of spectator arrivals and departures at each event based on past experiences. This information is provided by the event organizer or/and event specialist.
(e) Knowledge of the location of each event/activity in the city, which allows for the determination of the travel destinations of spectators and workforce. This input is provided by city experts and event organizers.
(f) Spectator origin is one of the most sensitive inputs. The origin of the spectators, including locals and visitors alike, can be estimated from the ticket price and spectator profile, which indicate socioeconomic and spatial aspects of the city and/or its surrounding regions. Additionally, information on hotel zones as well as apartments available for temporary renting, which is available on the accommodation portals of visitors, informs this estimation. These considerations are fundamental for sizing the demand to be placed on the public transport system. In addition, the origin of potential workforce, typically comprising local residents, can be estimated by the spatial distribution indicated by the compensation offered by the organizer. This information is provided by city experts and event organizers.
(g) Knowledge of the location of each session of the event and the public transport network available, provided by city experts.
(h) Knowledge on the distribution of trip demand origins, provided by city experts and event organizers.
(i) Demand modal split, which estimates the reliance on public transport usage. Regardless of the estimation, it cannot be assumed that 100% of the spectators will use the public transport network, since trips will also be made by foot or other modes (i.e., taxi, shuttle buses, carpool, and the bike). Considering this, and based on previous mega event experience, a reduction in this percentage is necessary. This input is provided by city experts and event organizers.
(j) Demand allocation for the mega event and evaluation of corridors as it relates to the expected demand, especially considering background

demand. VaRious scenaRios need to be developed, considering weekdays and weekends. This information is provided by city experts.

It is vital to size the necessary public transport supply on the basis of these evaluations to meet the estimated demand placed by the mega event, encompassing the needs of both spectators and workforce. This includes the provision of special public transport services tailored to meet this demand to ensure the timely arrival and departure of attendees and event participants.

This analysis is essential to assess when peak hours coincide, the impact they may exert on city services, the need to provide additional transport services, the necessity to create any temporary configuration of public transport terminals and stations, and/or the need to segregate different terminals, to name a few.

Once planning at the macro scale has defined the expected magnitude of mass movement, micro scale mobility planning is fundamental when designing the last link for entering and exiting the event site(s). This last-mile link is critical to the overall success of the entire mobility planning process. Utilizing the outputs generated from the Four-Step Model, mobility planning at the micro scale demonstrates how the total expected demand correlates with the planning of last-mile pedestrian transportation for mega events.

At the micro scale, the parameters outlined in the Highway Capacity Manual (HCM2010, 2010) for pedestrian level of service were considered to evaluate the last-mile component, which pertains to the final leg of travel leading to the venue. For security purposes, the last mile in mega events is confined to the venues' immediate spaces, and travel within the last mile is restricted to pedestrians and accredited vehicles, including public transport services. Authorized vehicles have predefined pick-up and drop-off locations, which can be on or off public roads, so as to not compromise the event's safety and meet service-level requirements (CET-Rio, 2016). This measure reduces the risks of terrorist attacks and facilitates crowd management.

Spectator access in the last mile occurs on foot, starting from the closest public transport stations, which should be location within a radius of 1,200 meters from the venue entry point (IOC, 2013). With this distance, it is possible to dilute the flow of pedestrians in times of great congestions, such as during the evacuation of a stadium after the end of a mega event. Long walks from the venue's exit point before boarding public transport are quite common. This strategy of lengthening distances is fundamental for transportation to be able to absorb the concentrated departure of the public after the end of the event.

The Rio 2016 Case

The Rio 2016 Olympic Games took place from August 5–21, 2016. Approximately 7.5 million tickets were available for purchase. Assuming that each spectator, on average, purchased three tickets for different sessions, and all available tickets were sold out, the number of spectators was expected to be 2.5 million people. This demand served as the primary data point, incorporated into the Four-Step Model. The available regional and metropolitan public transport networks connecting the four sporting clusters, which comprise the following, Fig. 12.1 were also considered:

- Five commuter rail lines (Deodoro, Santa Cruz, Japeri, and Belford Roxo e Saracuruna), extending approximately 270 kilometers covering 102 stations.
- Three metro lines (Lines 1, 2, and 4), extending approximately 57 kilometers and covering 41 stations.
- Three Bus Rapid Transit (BRT) corridors (Transoeste, TranscaRioca, and Transolímpica), extending 120 kilometers and covering 134 stations and terminals.
- One light rail line, extending 9 kilometers and covering 18 stations.
- Four ferry lines (Fig. 12.1).

One of the outputs of the Four-Step Model process involves estimating the demand that would be placed on the entire public transport network, categorized by transportation mode. The table below, presented in Fig. 12.2, demonstrates this demand.

These numbers provide a glimpse into the magnitude of the Rio 2016 Olympic Games, and, by consequence, the complexity of its planning

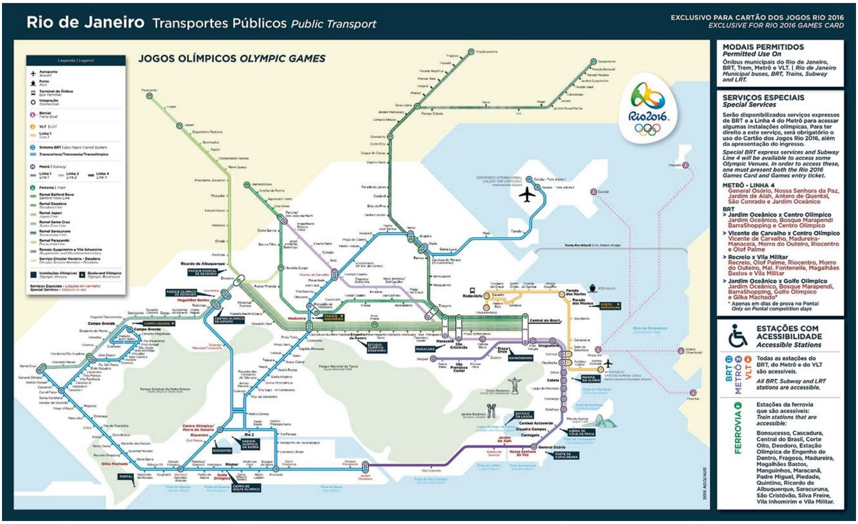

Fig. 12.1 Transport network during Rio 2016 Olympic Games. *Source:* CET-Rio (2016)

and operation. To reach the demand estimation per transport mode, the tickets were divided according to the following sporting zones (see Fig. 12.2):

- Barra da Tijuca—The Barra Olympic Park, Riocentro, Olympic Golf Course, Pontal, the International Broadcast Center, and the Main Press Center received 52% of all entries.
- Deodoro—The Olympic Park at Deodoro, Deodoro Radical Park, and the Equestrian Center received 12% of all entries.
- Maracanã—The Maracanã Stadium, Maracanãzinho (Little Maracanã), and the Sambódromo Olympic Stadium received 29% of all entries.
- Copacabana—The Beach Volleyball Arena, Copacabana Fort, the stadium at the Rodrigo de Freitas Lagoon, and Marina da Gloria received 7% of all entries.

In the case of Rio 2016, given this demand, a supersaturated public transport network was expected, which required the implementation of additional travel demand management strategies to prevent system

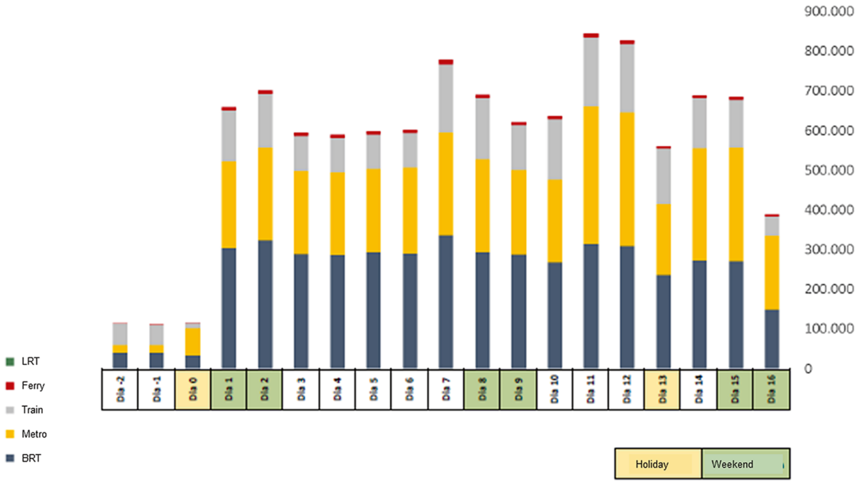

Fig. 12.2 Public per day per transport mode—Rio 2016. *Source:* CET-Rio (2016)

collapse. For operational and safety reasons and the need to adapt the supply to the demand of passengers during this peRiod, Line 4 of the subway, the BRT Transolímpica, and the initial section of the BRT Transoeste, called Lot 0, operated differently from the rest of the city's transport network. Furthermore, access to this component of the transport network was available to individuals with a special ticket (limited quantity) and accredited Games stakeholders, primarily ticketed spectators and workforce, respectively. Furthermore, certain holidays were considered in order to reduce background demand. These strategies have also been employed in other mega events in the city such as Rock in Rio.

Once the demand on the public transport system has been met, focus is directed to the last-mile link to venue sites. In collaboration with the local organizing committee and in alignment with the recommendations issued by the International Olympic Committee, public transport stations to be used during the Rio 2016 Olympic Games were identified. These stations were usually approximately 1,200 meters away from the venue entry. For many people and certain audiences, this distance is difficult to cover by foot and, in some cases, insurmountable for people with disabilities and reduced mobility. Hence, organizers, in conjunction with the host city, should take additional steps to make the event fully accessible. In other editions of the Olympic and Paralympic Games, among other alternatives, "blue badge" parking (vehicles identified with the International Symbol of Access) was made available in the competition facilities if pre-scheduled (Olympic Delivery Authority, 2012). In the case of the Rio 2016 Olympic and Paralympic Games, the city of Rio offered a complementary accessible transport service (shuttle) comprising modified buses and vans to assist in navigating the last mile (Silva & Fonti, 2017).

This last-mile complementary bus service met the following criteria:

- It was provided for locations where the walking distance exceeded 500 meters.
- The service identified and selected a station for use when more than one station could serve the venue. One of the criteria used for choosing the preferred station was ease of access to the adapted vehicle at that station/stop.

In estimating the possible demand for this complementary service, specific assumptions were made in addition to those used for the general public. These included the following:

- Of the total spectators 0.75%–1.20% would be individuals using wheelchairs.
- Of the total spectators 2.25% would constitute people with reduced mobility (Fig. 12.3).

In addition to planning for complementary services within the last mile, it is often necessary to rely on temporary pedestrian infrastructure. It is not practical for a city to build permanent ramps, pedestrian bridges, and walkways and stairs for public movement, which, depending on the location, can be utilized by 25,000 people per hour, especially if this demand would not normally occur in the day-to-day life of the city. This was the case with the Barra Olympic Park during the Rio 2016 Olympics, as well as the London Olympic Park and the Queen Elizabeth Olympic Park in 2012 in London. For example, given the planned layout and

Fig. 12.3 Example of accessible bus service for people with reduced mobility in Rio 2016. *Source:* Author's personal archive (2016)

pedestrian access at the new BRT Olympic Terminal at the Barra Olympic Park, a temporary pedestrian bridge was necessary to grant direct access to the Olympic Park during the time of the Games.

Adequate sizing of temporary pedestrian infrastructure is a key component of managing the flow of people to and from venue access points. In the case of Rio 2016 Olympic Games, the temporary infrastructure was sized considering LOS D, with an estimated capacity of 3000 pax/m/hour for ramps and 2100 pax/m/hour for stairs. Considering this LOS and based on the demand of arrivals and departure from the BRT Olympic Terminal, the pedestrian bridge at the Terminal reached 8 meters in width, with the stairs inside the Terminal reaching 12 meters (see Fig. 12.4). To cater to wheelchair users and elderly people, options included ramps and accessible shuttle buses. Additionally, two permanent ramps were used as an accessible alternative. In addition to adequate

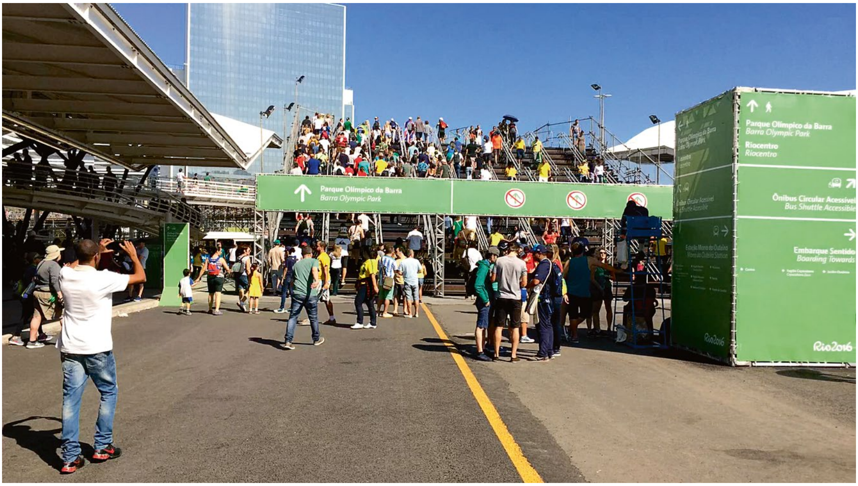

Fig. 12.4 Temporary pedestrian infrastructure at the BRT Olympic Terminal. *Source:* Author's personal archive (2016)

sizing of temporary pedestrian infrastructure, special operation of the bridges and/or ramps should be considered for effective management of large flow of people. Figure 12.4 demonstrates both the size of the temporary pedestrian bridge at the BRT Olympic Terminal and the signage indicating expected pedestrian flow.

The case of Rio 2016 taught that planning at the micro scale is critical to the overall success of an event. Still, each mega event has its unique demand and needs, and the addressing and management of these is critical for preventing the collapse of the available transport systems.

Integrated Monitoring

The Olympics experience provides a deeper understanding of the operational interfaces between different transport systems, especially when dealing with different levels of government. In 2012 in London, a very innovative transport coordination unit was established that operated during the Games. In 2015, the Integrated Urban Mobility Center (CIMU, Portuguese acronym) was created in Rio de Janeiro. The CIMU is a monitoring transport coordination unit that operates within the City Operations Center (COR, Portuguese acronym) during the Games, with representatives of all transport operators from across the entire metropolitan area of Rio de Janeiro.

Along with the issue of infrastructure delivery, communication and public dissemination also posed a challenge in operational planning. Approximately one year before the Games, modifications planned for mobility were known only to the technicians who had worked directly on their development. It was necessary to communicate to the public how to use the new public transport infrastructure, what changes were being made to the bus lines, where the Olympic lanes would be located, and the roadway events that would greatly limit mobility. With regard to the dissemination of information and usage of public transport, partnerships with existing international applications were formed. In this manner, nothing new was created, and the application could be accessed in vaRious languages.

The CIMU format, created for the Rio 2016 Games, aimed to facilitate the integrated management of the transport operation for the Games. This comprehensive approach included promoting the integration of all operational plans for each transport mode. This enabled speedy identification of problems in the network, facilitated situational analysis, informed decision-making, and promoted the execution of integrated responses to problems in the network. Additionally, it served as the official source of information for the Games' mobility operation, benefiting citizens, visitors, and operational teams of the transport providers and/or agencies involved.

With a team of approximately 60 people, the CIMU room operated 24 hours a day, enabling the following practical results that illustrate the significance of the initiative.

1. Seven positions were reserved for the coordination of CIMU, and these positions were occupied by representatives of the following entities:

   (a) Public transport agencies
   (b) Transport concessionaires

   (c) Other Partners—Rio 2016 Local Organizing Committee, security detail, mobility apps, and remote representatives from the airports and taxi services

2. Response to occurrences and transport problems: Throughout the Rio 2016 Games, 105 events related to public transport were recorded—all of which were handled by the CIMU team, utilizing situation analysis, response execution, and sharing of critical information among field teams.
3. Implementation of contingency plans: The presence of a plan with the list of contingencies and mapped risks pRior to the start of the Games facilitated immediate responses to situations.
4. Direct communication with passengers: Utilizing COR's social network, mobility applications, and text messaging services, the CIMU was able to send immediate messages regarding the transport system. During the Rio 2016 Games, more than 400,000 readings were recorded (statistical data from communication platforms). More than 550,000 trips that were generated using mobility apps and approximately 3.5 million geo-located alerts were sent to public transport users.
5. Crowd Management Group for Contingencies: With the development of contingency plans for critical transport problems, the CIMU Management Committee identified the need for a group specialized in crowd management to inform the public in the event of large-scale occurrences. To meet this need, local security forces were trained in specific procedures to manage large gatherings.
6. Technological integration was conducted through the software developed especially for CIMU: *Palantir*. This system used planning data with estimated audience numbers arriving and leaving sessions for each day of the Games and indicated the Olympic facilities with the highest occupancy. *Primus*, another component of the system, was used for registering planned actions, such as the start and termination of competitions, and it ensured that the competitions took place as scheduled. In addition, messaging apps such as Telegram and WhatsApp were also used for communication and coordination.

Currently, the CIMU exists in a hybrid format, with both in-person and online representation, facilitating the daily operation of the city.

Main Results

The main findings obtained from the Rio 2016 case study is that effective planning at the macro scale, utilizing the Four-Step Model, micro scale pedestrian planning, and integrated operations and communications are critical components of a successful event. As has been observed, many inputs and analyses are needed to guarantee a high-level experience to the public, encompassing residents, spectators, and workforce. Collaboration between transport and public agencies as well as event organizers is highly recommended for assured success. This collaboration is not only essential to the success of the event, but it also contributes significantly to the perception of a substantial increase in high-performance public transport utilization and has a highly positive impact on the city's public image.

The Rio 2016 Games transport legacy of adding 170 kilometers of transport infrastructure and the establishment of the Integrated Urban Mobility Center, together with lessons learned from previous mega events, allowed the City of Rio de Janeiro to pioneer a successful methodology for transportation operations for mega events. The foundation that the Rio 2016 Games established has served the city well for all mega events that have followed since. The city received several accolades that contributed to the overall positive perception of the city's successful public transport operation during the Rio 2016 Games. The spotlight from the national and international press on Rio during the Games resulted in positive headlines. Some of these headlines include the following: *Integrated Transport in Rio Works Well*, which featured in a São Paulo newspaper on August 7, 2016, and *Legacy of the Olympics in Transport: Drivers Realize the Advantage of Leaving the Car at Home*, which appeared in *O Dia*, a Rio newspaper, on August 14, 2016. Spectator surveys carried out by the local organizing committee of the Rio 2016 Games revealed high approval rates regarding transportation in the city.

The city of Rio de Janeiro continues to put in practice the key takeaways from hosting mega events, which includes a truly integrated urban mobility network. This has enabled the city to take full advantage of the available transport infrastructure, planning, and communications necessary for hosting successful mega events.

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Accounting for Social Value in Urban Security: Social Return on Investment of SURE

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Introduction

Nowadays, the relationship between urban security, public management, and return on investment has become more critical and tangible. Urban security and safety are crucial issues that affect the lives of millions of people worldwide. Gradually, all cities around the world have evolved with new technologies and security methods. Events such as the 9/11 attacks or the COVID-19 pandemic have been catalysts for deep changes in how surveillance systems are utilized and normalized, whereas their presence is now a seamless component of the daily routine life of citizens worldwide. Within a surveillance society (Lyon, 1994), numerous different technologies are at play, whose impact on society is often little

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understood or even misconstrued. In efforts of advancing the employment of practical frameworks in capturing the impact of public investments, this chapter introduces the application of social return on investment (SROI) analysis in the context of urban safety and security. A primary motivation to explore this topic can be traced to the increasing popularization of urban security technologies in many cities such as London, Amsterdam, and Paris, to name a few. Second, the SURE project built a technological solution utilizing CCTV as the main technology to ensure security for the city of Tampere—the object of study of this chapter. Third, urban security is of strong interest to local municipalities by virtue of being closely connected to the strategic themes of city vitality, quality of life, and well-being.

Public investments are part of urban safety and security work to ensure that people and public spaces are safe and secure. However, such investments must be made with consideration for four key factors: economy, efficiency, effectiveness, and social equity, or the 4E's. Economy denotes the need for investments to be cost-effective, while efficiency signifies the need to ensure that resources are utilized in the most productive manner possible. Effectiveness, on the other hand, is concerned with the extent to which investments achieve their intended goals, while social equity pertains to ensuring that benefits and costs are distributed fairly across different groups of people and generations (Bailey, 2004).

According to Braga and Weisburd (2010), the key to making effective investments in this area is to adopt a problem-oriented approach that focuses on identifying specific issues and developing tailored responses. Moreover, it is essential to ensure that such investments are made in a manner that is both efficient and cost-effective, with resources allocated in a way that maximizes their impact (Braga & Weisburd, 2010). Ultimately, investments in urban security and safety must be made with social equity in mind, ensuring that the benefits and costs are distributed fairly across different groups of people, with a particular attention to those who are most vulnerable and marginalized (Robinson, 2017) and the age groups that will eventually pay back these investments (Bailey, 2004). Public investments in urban security and safety have the potential to contribute significantly to the well-being of urban populations. However, the effectiveness of such investments is dependent on several factors, including the context in which they are made and the resources available.

Measuring the value of public money is pivotal from the accountability perspective; taxpayers have a right to know the return on investment for the money expended. Another important reason for this measurement is to gain insight from the management and decision-making standpoint into the results of public actions and the effectiveness of the decisions made. However, a particular problem is encountered in demonstrating the effectiveness of policy actions and security policies. Identifying the actual results of public actions and the factors that contribute to the desired outcomes can be ambiguous and challenging (Autero, 2012).

The impact of public investment on society has become an increasingly important topic. To delve deeper into this issue, this chapter will examine a specific case: SROI. To conduct our research, we utilized a combination of qualitative and quantitative data, and our primary focus was on answering the following research question: *How can the social return on security investments (SROSI) help in accounting for the socio-economic impact of multi-stakeholder security investments on public spaces?* The answers to this question are obtained by applying the SROI analysis to the Smart Urban Security and Event Resilience (SURE) project, which seeks to enhance safety and security capacities during urban events in Tampere, Finland. Our analysis delves deep into the socio-economic value created by the project in the city of Tampere, using a non-exhaustive list of indicators to test the suitability and the potential of novel methodologies such as SROI in measuring value within public policy. This chapter supports the development of a holistic understanding of the impact and transformative effects brought about by Public Private Partnerships (PPP) in the realm of safety and security.

Theory-Based Evaluation and Theory of Change

In the discourse surrounding program theory development and evaluation, terminologies such as program theory and theory-based evaluation have been widely used (Rogers, 2000). Program theory highlights the mechanisms of change, providing information for replication or improvement (Weiss, 1997). A classic example by Pawson and Tilley is presented in their book, *Realistic Evaluation* (1997). Tilley (1993) explored the mechanisms of change involved in the reduction of auto theft in parking lots as a result of the presence of CCTV through the lenses of deterrence and passive surveillance. Other examples of theory-based interventions include adolescent substance abuse prevention through the involvement of the nuclear family (Rogers & Weiss, 2007). A substantial amount of theory-based evaluation pertains to health promotion and risk prevention programs (Rogers & Weiss, 2007). Authors in different universities and research groups have reinstated the significance of monitoring and evaluation in supporting democratic practices in governance and accountability (Hanberger, 2013). According to Weiss, the aim of the evaluation is "to measure the effects of a program against the goals it sets out to accomplish as a means of contributing to subsequent decision-making about the program and improving future programming" (Msila & Setlhako, 2013).

Theory of change, alongside other approaches such as realistic evaluation, emphasizes the role of contextuality, which is crucial in determining causation (Blamey & Mackenzie, 2007). Weiss developed the theory of change on the basis of theory-based evaluation (Weiss, 1997). She emphasized health promotion and risk prevention as the main areas that can benefit from theory-based evaluation (Rogers & Weiss, 2007). Basing evaluation on theory rather than the practitioner's assumptions became the driving force behind theory-based evaluation. Theory-based evaluation acknowledges the self-agency of recipients, rather than considering them as passive recipients of activities aimed at improving their social or health standing (Blamey & Mackenzie, 2007). It thereby focuses on mechanisms at play from service delivery to occurred outcomes. The said mechanisms constitute the participants' responses to the services offered by a program (Rogers & Weiss, 2007, p. 73). For instance, in a program advocating for the use of contraceptives, the advocacy itself is not the mechanism but the knowledge gained by the counseling or the boost in confidence in the women who participated (Rogers & Weiss, 2007). Similarly, in the SURE project, the mechanisms at play are not the delivery of security technologies (i.e., CCTV) itself but the enhancement of security through various mechanisms, such as deterrence, which accounts for 16% of the impact (Piza et al., 2019), and the sense of safety experienced by event attendees. The theory of change secures the foundation for the SROI analysis, with the latter being built upon the former. In the next section, the SROI methodology will be explored in greater detail.

Public Sector and Measurements: Social Return on Investment as an Instrument

The public sector exerts a direct and profound impact on the lives of residents. Measuring the outcomes of the public sector has gained international traction. The importance of performance measurement in public sector organizations has been further emphasized by new public management, whose objective is to adopt the performance measurement methods used in private organizations for organizations in the public sector to enhance the effectiveness of its activities and ultimately satisfy the needs of the users (Balaboniene et al., 2015). Rantala and colleagues (2018) explored the designing and building performance measurement systems in the context of collaborations between universities and public organizations. Public sector officials employ outcome evaluations to determine the past performance of programs and allocate future resources based on that.

In determining the performance of projects and their impact, resource allocation often extends beyond financial value, although typically it is the focal point in impact evaluation. The SROI analysis uses a much broader definition of value, thereby measuring change in ways that are pertinent to the individuals or groups that participate in or experience it. The SROI methodology uses quantitative and qualitative measures of change and assigns monetary values to represent them, thereby illustrating the magnitude of the change. Serving a retrospective and prospective role, SROI can be evaluative or have a forecasting approach. While the former is concerned with evaluating the impact of past activities, the latter deals with anticipating the impact of current or future activities. For the SURE case, a forecast SROI analysis was conducted, anticipating the impact of the project upon completion.

The SROI analysis is largely based on the theory of change—a framework developed and pioneered by Roberts Enterprise Development Fund in the 1990s (Measurement & Evaluation, 2023). It evaluates the social benefits created by enterprises through the measurement of outcomes. Essentially, it measures the value of benefits in relation to the costs of obtaining those benefits (Ariza-Montes et al., 2021). It is based on social and environmental accounting principles, with stakeholders at the heart of the analysis. The SROI analysis for the SURE project was conducted internally, following the notion that internal evaluators in theory-based evaluation are at an advantage compared to external ones because they understand the beneficiary groups as well as the organizational structure, goals, and philosophy of the program being studied (Conley-Tyler, 2005).

SROI is an evaluation framework that explores all aspects of change and its impact on different stakeholders, extending beyond just organization's financial sheet. Safety- and security-related activities are often concerned with intangible outcomes that are difficult to measure despite their potential significance. The nexus between the public sector, safety and security, and SROI has not been explored in literature despite having rich implications. Previous studies have applied the SROI analysis to fields and research questions that are highly experiential. For instance, Bradly & Bolas (2013) focused his research on measuring the value of the treatment work in the context of drug and alcohol misuse among youth in England. Bradly & Bolas (2013) found an SROI ratio of 3.91 pounds for every 1 pound invested in reducing substance misuse in young people. The research also focused on crime prevention, where the ratio of benefits to costs was 1.87 pounds per person (Bradly & Bolas, 2013). In assessing the social impact of a football club and its philanthropic organizations on the local community, Lombardo et al. (2019) found an SROI ratio of 3:1, suggesting that each euro invested by the football club yielded a return of 3 euros. Among others, the beneficiary stakeholders were shopkeepers whose revenues increased, families whose children saw improved physical and emotional conditions, and the municipality whose image was improved (Lombardo et al., 2019).

Extending the SROI analysis to local culture, Viganó and Lombardo (2019) evaluated the impact of the Museum Association in Florence (MUSE). The authors derived the SROI of MUSE through the use of proxies developed to measure impacts from cultural activities. These proxies included measurement of the appetite for the consumption of cultural goods through the willingness to pay (WTP) method and semi-structured interviews, thereby estimating a 3:1 SROI ratio, indicating a 3 euro SROI per euro invested (Viganó & Lombardo, 2019). There is a lack of literature applying the SROI analysis to safety and security, although the latter especially deals with intangible benefits, such as a sense of safety for residents. Although the SROI analysis has found wide use in various projects and organizations, there is a lack of literature using this framework for public security investments in an urban setting. This chapter contributes to the novel attempts to account for socio-economic value in public safety, being one of the first studies to investigate the impact of public security investments on several stakeholders through the SROI framework.

CCTV as an Instrument of Crime Prevention

Societies have become more militarized, where what was once deemed as war technologies, such as CCTV, are now part of the citizens' daily lives. Graham (2011) argued that we are living in an era of urban security, which he referred to as *new urban militarism*. In this context, high-tech security systems have become the most critical component of a city, such as internet GPS technology, mobile phones, face recognition technology, command and control rooms, and so on. Graham (2011) proposed that the world underwent a deep change after the 9/11 terrorist attacks, with surveillance becoming an integral part of the fabric of contemporary life. Surveillance technologies started to use the language of fear to install their tools in society, and the entire society became enveloped in a culture of control (Virilio & Richard, 2012). This shift saw countries around the world implementing systems that prioritize increasingly rapid responses, rendering the speed of information paramount.

Although Paul Virilio did not see what happened before the attacks, he understood the logic behind the fear, speed, and power when he said, "We will see the creation of a common feeling of insecurity that will lead to a new kind of consumption, the consumption of protection; this latter will progressively come to the fore and become the target of the whole merchandising system" (Virilio, 1986, p. 139). In the contemporary context, the predominant use of CCTV in public spaces can be attributed to two central factors: risk management (Beck, 1992) and fear administration (Virilio & Richard, 2012). As Virilio and Richard (2012, p. 47) highlighted: "The occupation places us under surveillance, watching us, scanning us, evaluating us, revealing us and is it increasingly present, increasingly accepted as a fate, destiny." As the author suggested, the new possibilities of watch and surveillance cannot be questioned but just have to be accepted. The promise to reduce crime and make the cities more secure is popularizing the surveillance system of CCTVs around the world.

This phenomenon has spread to many European spaces that exhibit significant growth in monitored public spaces, such as London, where a 40% growth was observed, followed by Oslo with a 38% increase, Copenhagen, with a 33% increase, and Budapest with 28%. However, it is the level of acceptance of this type of surveillance in some spaces that draws attention: In banks, 91.9% of those surveyed said that they accepted surveillance; in the landing platforms, acceptance was 86.7%; in malls, it was 62.5%. These data demonstrate a certain passivity toward the invasion of privacy (Urbaneye Project, 2004). It is estimated that approximately 770 million cameras are in use around the world, contributing to an expanding market that has attracted more than 40 billion dollars in investments (Global CCTV Cameras Market, 2022). This development has made this market more lucrative but has also raised significant concerns related to, for example, privacy and the replacement of human beings by machines.

Lyon (2007) argued that with the advent of modern surveillance, the social dimension started being perceived as something controllable, as data on behavior, consumption, and individuals' daily life started being processed by supercomputers to produce large databases that can be used by private and public corporations, in what he termed the "surveillance society." In this process, bodies became barcodes or hashes to be decoded by technological systems (Deleuze, 1992). According to Graham (2011), security has exceeded national terrorism, and now cities are living in a global surveillance society. For Martin (2006), the war provides the world a new way of thinking about military technologies and securitization. He demonstrated that massive surveillance systems are a result of the combination between militarization and securitization, and the CCTV technology is one of the biggest components of this process. According to Boyle and Haggerty (2009), after the 9/11 attacks, urban securitization processes have become legitimized and, especially, CCTVs have become a major player in ensuring a successful event.

Following this idea and in an attempt to better understand the relationship between CCTV and security mechanisms, Welsh and Farrington (2009) conducted a study connecting public areas, CCTV, and crime prevention. They performed a meta-analysis of 93 relevant papers. For them, "the prevention of personal and property crime is among the primary objectives in public space. As an intervention targeted at crime, CCTV is a type of situational crime prevention" (Welsh & Farrington, 2009, p. 717). In their study, they observed a relation between CCTV and many different crimes, and their results demonstrate an approximate 16% reduction in crimes in areas that utilize this technology compared with non-CCTV areas. After 10 years, Welsh and Farrington in collaboration with new colleagues performed a similar study. Piza et al. (2019) updated the meta-analysis on CCTV and crime prevention, reaffirming the previous finding of a 16% reduction in criminal activities. The authors argued that the relationship between crime prevention and CCTV became a public policy around the world. However, CCTV exerts a more profound impact on certain types of crimes, such as criminal activities in car parks and house burglaries, than others. "According to the application of video surveillance, there are three basic functions of video surveillance in the field of public security and order: protection and prevention, detection, and collection of evidence" (Socha & Kogut, 2020, p. 2).

Giulianotti and Klauser (2010) proposed that investments in event security have been significantly influenced by the war on terror and the 9/11 attacks. The security for large events also became inextricably linked to the use of cutting-edge technologies, with smart technologies for monitoring crowds gaining utmost prominence. Giulianotti and Klauser (2010) highlighted three primary areas of urban risk related to large-scale events: terrorism, police violence, and urban crimes. In such cases, smart security technologies have become a major instrument for both controlling social problems during events and providing a sense of security. Khan et al. (2020, p. 57) postulated that "The number of CCTV cameras should be sufficient so that people can feel safe from the fear of crime." The safeguarding of public spaces from such risks aligns with the SURE case, which also utilizes CCTV in public spaces to ensure the feeling of security and safety. However, caution must be exercised to prevent reductionism in the implementation of this solution, as an over-reliance on technology may lead to a techno-solutionist approach that oversimplifies the complexity of the issue at hand. Matczak et al. (2022) investigated in their research the monetary return on investment into the use of CCTVs in urban spaces to better understand the relationship between CCTVs and the social impacts of these technologies. According to Khan et al. (2020, p. 49), "Technology has allowed us to take benefit from it, make life quite easier and comfortable." This stance ratifies the belief that despite issues related to privacy, invasion of everyday life, and social changes, if well used and applied, CCTV can be an ally in public safety. In this chapter, we use the general number of 16%, as calculated by Welsh and Farrington (2009), as a proxy for estimating the crime-reducing effects of SURE in the project's targeted areas.

Methodology

The SROI methodology is often considered to have a mixed design. According to Denzin and Lincoln (2005), although qualitative research was initially employed in anthropology and other social sciences, it must be understood as a space for the construction of social criticism, which makes it complementary to the purpose of this analysis. Simultaneously, the insertion of quantitative data makes the research more robust. We opted for an investigation through a single case study in conjunction with the SROI methodology. The case study is a typical technique for obtaining data, providing a structured approach for organizing the data around a certain research unit. Single case studies are more holistic as they require extensive research. Yin (2002, p. 14) stated that an investigation that is characterized as a case study, whether single or multiple, "[…] arises from the desire to understand complex social phenomena" and "[…] retains the meaningful and holistic characteristics of real-life events." The following criteria were established for the selection of cases:

1. Facing a technically unique situation
2. Relying on variable sources of evidence
3. Benefiting from the prior development of theoretical propositions to conduct data collection and analysis (Yin, 2002).

This research defines the SURE project as an innovative urban action, combining new technologies to increase urban security. In this sense, we employed qualitative methods such as semi-structured interviews, surveys by Google forms, discourse analysis, and observation to make the SROI methodology stronger and more holistic. Regarding the quantitative analysis, the focus was on the monetary outcomes and value related to security safety and the events that we collected data on. In the calculation of the proxies, we utilized publicly available and privately acquired data from the police, State Treasury, and the Finnish Institute for Health and Welfare. To gather a sizable number of detailed stories for evaluating the effects of the SURE project on event attendees, we spoke with a sample of various stakeholder groups. Surveying stakeholders who would most benefit from the activities under analysis was critical to the computation of outputs and outcomes. Thereby, we conducted semi-structured interviews with first-line responders who use the SURE tool. Furthermore, a survey was distributed, collecting information on the experiences of event attendees in the Tampere city center concerning safety and security. Event participants' appetite for safety and security measures was computed using the WTP method.

The SROI ratio is calculated by measuring the present value of benefits over the total value of inputs. The results are expressed in the form of a ratio of benefits to costs. Expressed mathematically, the SROI is measured using the following formula:

Table 13.1 Corpora

Type of data	Data collection	Quantity
Qualitative	Semi-structured interviews	5
Qualitative	CCTV survey	77
Qualitative	Willingness to pay	48
Quantitative	Police crime statistics, Tampere	1
Quantitative	Cost of crime statistics—HELDA	1
Quantitative	State treasury statistics on compensation and accidents	1
Documentary	Report	10

$$\alpha - \beta\gamma = \text{SROI ratio}$$

Where,

α = Impact
β = Deadweight, attribution, displacement, drop-off
α–β = Present value of benefits
γ = Total value of inputs

Once the case and the methodology were defined, the research proceeded to the next step, which was the construction of the corpus. Corpus refers to a set or collection. Sinclair (1991) stated that a research corpus constitutes a collection of texts selected to characterize a given study. Once the construction of the corpus commences, another term that comes into play is the concept of corpora. W Bauer (2000) proposed that for an orderly construction of a corpus, several corpora must be created (Table 13.1).

Results and Analysis

This section presents the results of the SROI analysis conducted for the SURE project, which serves as our base case study. SURE is aimed at increasing cross-sectoral preparedness for threats against public spaces and other urban security threats in Tampere. In Tampere, the key destinations targeted by the SURE project have been Keskustori, the marketplace in the city center, and the Tampere Stadium. Nokia Arena, the new multipurpose arena in the heart of the city, has also been considered in the SURE project. The stakeholders included in the SROI analysis for SURE primarily constitute event attendees, first responders, and the city and its agencies.

To test the relevance of the SROI analysis in urban security investments, we conducted a test analysis using a few indicators. The SROI analysis employs proxies to convert qualitative and intangible effects into quantitative variables. In this context, impact has been categorized as either "economic" or "social." An appropriate "proxy" was chosen for each indicator, and the influence over time was assessed in the context of expected impact (duration). Monetization was based on methods of contingent evaluation, WTP, and cost prevention.

Effects on Crime-Related Damage to Society

The cost of crime has been categorized into four (McCollister et al., 2010). Victim costs involve direct tangible losses borne by the victim of the crime, such as the cost of medical care and the cost of belongings damaged in the act of the crime. Criminal justice costs refer to the costs incurred by the local and national governments, such as expenditure on incarceration and legal services. Crime career costs refer to the opportunity costs incurred by the perpetrator of the crime in engaging in criminal activity, representing the missed earnings in the legal sector. Finally, intangible costs refer to intangible losses incurred by the victims of crime, such as psychological distress (McCollister et al., 2010). To estimate the impact of SURE on crime-related damage to society, the costs of crime explored in this chapter primarily pertain to criminal justice costs and intangible costs. In this sense, the SROI analysis for SURE was conducted utilizing the following indicators: effects on investigative costs, victim losses, conflict resolution, inter-institutional knowledge transfer, and sense of safety of event attendees. The reduction in investigative costs and conflict resolution expenses following a 16% drop in crime pertains to the criminal justice costs, as indicated by McCollister et al. (2010). On the other hand, the drop in costs related to victim losses pertains to intangible costs, such as psychological distress.

Effects on Investigative Costs

The cost of investigating a crime in Finland stood at €825 in 2008 (Hinkkanen, 2008). With an average annual inflation rate of 2.08%, this translates into an expenditure of €1100 per crime investigated in 2022. Given the estimated 16% decrease in crime, the crimes avoided due to preventive technology create a monetary impact of €1.35 million.

Effects on Victim Costs

We explored the intangible costs incurred by victims. Crimes involving violence are usually associated with large intangible costs (Wickramasekera et al., 2015). The cost of crime borne by victims was evaluated using the victim compensation scheme as a proxy for losses incurred by victims, such as psychological distress or decreased quality of life due to victimization. Using public data on victim compensation schemes from the State Treasury (Valtiokonttori, 2019), we calculated the socio-economic impact created. This impact amounts to €2.2 million in savings as a result of reduction in losses incurred by victims due to the preventive technology of SURE, which stands at 16%.

Effects on Conflict Resolution

Mediation is offered on a voluntary and free-of-charge basis in criminal and certain civil cases (Elonheimo & Leivonen, 2021). Individuals submit a mediation request, and the mediation takes place upon obtaining consent from all parties, which can be withdrawn at any point of the process. During 2019–2020, 53% of the cases filed nationally involved violent crimes. During the same years, the Pirkanmaa region recorded, on average, 662 violent crimes filed for mediation ("Rikos- Ja Riita-asioiden Sovittelu," 2021). As indicated by public data from the Finnish Institute of Health and Welfare, the preventive technology of SURE creates a monetary impact of approximately €50,000, considering the average cost per case to be €474.1.

Inter-institutional Knowledge Transfer

Response time is also linked to the speediness of technology-enabled interventions. In line with Virilio (1986) technologies such as command and control centers reshape our understanding of movement and security, affirming the impact of the SURE project. Efficiency and speed, in this case, promote a sense of safety and security, also for public safety officials such as first responders. Pointing to the argument that velocity is power, one of the interviewees B highlighted the following: "it keeps people back from committing crimes, also when it happens can get caught faster," referring to the use of technologies such as CCTVs to bring more velocity to crime resolution. Circling back to what Boyle and Haggerty (2009) argued, after the 9/11 attacks, the relation between events, security, and faster response has changed completely, with events now turning into potential terrorist scenarios that need to be protected. In this context, interviewee C's comment deserves mention: "Security and safety are super important. Helps people feel at ease and confident in the new and sometimes strange environment. If they can be at ease, they can enjoy it better whatever event it is." The Insta Blue Aware communication platform created within the SURE framework provides first responders with a joint communication platform and real-time shared data. Inter-institutional knowledge transfer is enabled through joint simulation exercises and a communication platform that supports speedy intervention. Using the market value of the activities as a proxy, the monetary impact of inter-institutional knowledge transfer amounts to €200,000.

Sense of Safety of Event Attendees

The relation between surveillance technologies and sense of safety is complex and difficult to define. According to Ratcliff and Rosenthal (2021), the principal argument in favor of utilizing CCTVs in public spaces lies in the positive economic return when people feel safe and secure. The authors employed some examples involving the integration of CCTV with public services, illustrating benefits such as quicker responses, knowledge about space displacement of crime (where criminal activity moves to a different neighborhood), improved data quality, and addressed privacy issues. The efficiency of the technology could be questionable. Graham (2011) built upon this idea and argued that the sense of safety needs to be carefully measured to avoid creating a misleading impression associated with techno-solutionism. In the context of events, which differ from daily life, participants feel more comfortable being watched, as highlighted by one of the interviewees: "It makes me feel protected because I know if something happens to people having cameras can easily detect everything and it helps the police to do their job." Our analysis finds that while CCTV is not a solution, in the context of events, it can serve as a supportive element in enhancing the sense of safety by virtue of its detective and preventive characteristics.

Willingness to Pay in Events

The WTP method and contingent evaluation have been widely used in identifying consumer preferences and appetite for services in economic research. Such methods estimate the amount of money that consumers are willing to pay for products or services (Hanemann, 1984). Contingent evaluation is a method that involves directly asking consumers about their willingness to pay for a specific good or service (Arrow et al., 1993). This approach is especially useful when consumers are unable to purchase the good or service in question directly, which is often the case with public goods. The utilization of methods such as the WTP method and contingent evaluation has significant potential in revealing consumer preferences and appetite for services. This approach sheds light on the value that consumers place on goods and services and can be used to guide the development of new products and services (Varela et al., 2001). Moreover, this approach can be employed to inform public policy decisions related to resource allocation in the provision of public services (Louviere et al., 2010). Although promising, there are notable limitations to this approach, especially when there is asymmetric information or external factors influencing willingness to pay (Hanemann, 1984). The survey conducted as part of this study evaluated what value event attendees place on security at events. It achieved so by evaluating the willingness to pay for security measures at events event goers had attended in the previous year (2022). As reported in the table below, 41% of the attendees place maximum value on security at events. To quantifying this value, the aggregate WTP for security was calculated as reported in Table 13.2, amounting to €1.2 million (Fig. 13.1).

Regarding the event attendees' perception of the impact of technology and the effectiveness of CCTVs in preventing crimes, the interviewee E highlighted the following: "In my opinion, it improves the security of everyone having cameras and sensors everywhere for example some accidents might have happened then CCTV cameras can contribute a lot in the community so that similar accidents can be avoided in the future." Considering the importance of analyzing the social impact exerted in relation to damage to society, we explored this concept through the example of event-related incidents in our interviews. However, this approach can be applied to all types of crimes, as demonstrated in Matczak's research. Dear et al. (2019) have also debated the relationship between CCTVs and crime prevention, estimating a prevention figure exceeding 16% when taking into account the deterrence of antisocial behavior that is not necessarily criminal. Specifically, beyond crime deterrence, Dear et al. (2019) indicated the effects of CCTVs in deterring disruptive behavior. Their meta-analysis reported a 35% reduction in disruptive behavior in the presence of "watchful eyes" (Dear et al., 2019).

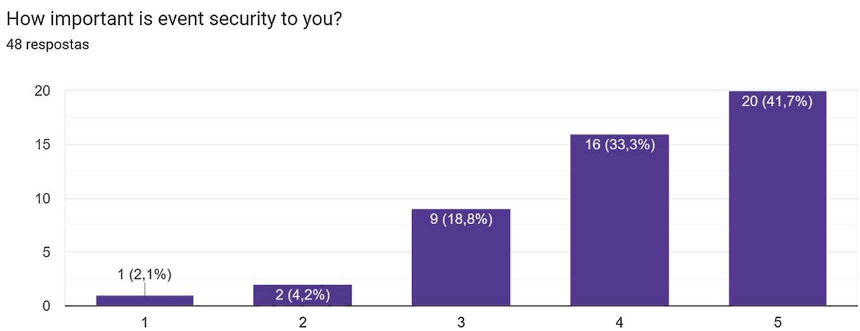

Fig. 13.1 How important is event security for you? *Source:* Authors (2023)

Table 13.2 Social return on security investment

Change area	Measure of change	Impact in euros	Type of impact
Effects on investigative costs	The possibility to reallocate resources for other uses following a drop in investigative costs due to the decrease in crime in affected areas Proxy: economic cost of crime investigation	€1.3 million	Economic
Victim losses	The drop in victim compensation following a 16% drop in crime in the affected areas Proxy: victim compensation scheme	€2.2 million	Social/economic
Effects on conflict resolution	The drop in the cost of resources allocated to conflict resolution following a 16% drop in crime in the affected areas Proxy: conflict resolution compensation scheme	€50,200	Social/economic
Inter-institutional knowledge transfer	The increase in confidence and knowledge due to simulation exercises and use of communication platforms supporting inter-agency collaboration and knowledge transfer in first-responder teams in Tampere Proxy: market value of simulation exercises	€200,000	Social/economic
Sense of safety of event attenders	The increased sense of safety of event attendees in the presence of security measures Proxy: contingent evaluation of event attendees' (WTP in Tampere)	€1.2 mill	Social
Total input	Project budget	€4 mill	
Total impact		€4.95 mill	
Ratio		1.2:1	

Deadweight and Displacement Effects

Deadweight refers to the extent to which outcomes included in the analysis would have occurred in the absence of the project's activities. In the SURE context, it could refer to the extent to which disruptive behavior in event areas would have dropped or the extent to which the sense of security of event attendees would have increased in the absence of SURE activities. Displacement, otherwise known as the substitution effect, refers to the extent to which the benefits experienced have been achieved at the expense of others that are not part of the project. Situational crime prevention methods such as CCTVs have been criticized for displacing crime (Skinns, 1998). However, there is no consensus on whether CCTVs indeed displace criminal activities (Waples et al., 2009). For instance, empirical evidence from Malaga demonstrated that the presence of CCTVs leads to a decrease in crime, while still displacing some of the criminal activities to nearby areas with no camera coverage (Cerezo, 2013). Other studies have revealed that spatial displacement of crime due to CCTVs does occur but is not detected frequently (Waples et al., 2009). The SROI framework recognizes the difficulty and subjectivity inherent in measuring displacement. Nonetheless, it still challenges evaluators to consider the displacement effect in evaluating impact.

In contrast to displacement, the benefits of situational crime prevention sometimes diffuse to other areas. For instance, Poyner (1992) discovered that cameras reduced crime not only in the areas where they were placed but also in nearby areas not covered by cameras. There is evidence to suggest that diffusion of benefits is as likely as displacement of crime (Welsh & Farrington, 2014). Additionally, observed displacement does not seem to be greater than the reduction in crime (op. cit., 2014). In the SROI analysis for SURE, we have not modeled displacement and deadweight effects due to the unavailability of relevant and reliable data. The inclusion of displacement and deadweight effects remains a critical challenge for future studies.

While the exclusion of displacement and deadweight effects may overstate the impact of the SURE project, we have reason to believe that the SROI ratio may be understated in other ways. To explain further, 4 million euros were designated as γ, representing the total value of inputs, which encompassed the entire project budget spanning over 3.5 years. At the output level, only a few outcomes were considered, such as simulation exercises and crime-reducing effects. Many outputs of the project were left out due to lack of data and the limited scope of this study. For instance, the fast response enabled by real-time data and a shared communication platform holds great potential in lowering healthcare costs due to early intervention in disruptive events. This can be illustrated by the experience of a first responder we interviewed. First response unit was able to intervene in a violent event in 3 minutes, while the wait time would have been 17 minutes in the absence of CCTVs. This happened because the footage revealed that it is safe for the ambulance to intervene without waiting for the police (which was 17 minutes away), since no threat or danger was detected. In this sense, avoided healthcare costs and increased safety for first responders are unaccounted for in this study.

Conclusion

This chapter has explored the intricate relationship between the public sector and technology in addressing urban issues while avoiding a techno-solutionism approach. The experiences gained from the SURE project have shed light on the areas of change that drive social return, emphasizing the importance of achieving a balance between the nexus among public management, security, and technology and how it affects citizens' lives. In Tampere, the presence of CCTV has been found to enhance citizens' feelings of safety in public spaces and events, as expressed by some individuals. The SURE project's strong network of stakeholders, including the public sector, universities, citizens, private companies, and other organizations, facilitates the building of an illustrative framework for public safety and security investments.

Public security is a complex issue with multifaceted problems and challenges. The application of SROSI methodology has allowed us to gain a realistic understanding of the impact of the investment made into the SURE project. Our main question of how SROSI can contribute to accounting for the socio-economic impact of multi-stakeholder security investments in public spaces has been answered through the findings obtained by applying SROSI methodology to the SURE project. These findings demonstrate the relevance of considering value beyond monetary returns. The SROI of €4.95 million or a ratio of 1.2:1 provides insights into the actual impact generated by the project' s activities, underscoring the importance of impact measurement frameworks that capture the multidimensionality of returns in public security investments, which are often neglected in impact assessments. The project's strong focus on a human-centric approach has been reflected in its results.

The increasing role of public security and urban security technologies, such as CCTVs, necessitates rigorous methods to evaluate their impact on cities and their residents. In this regard, the SURE project in Tampere has demonstrated the significance of creating an ecosystem around these technologies, considering them as tools rather than the sole solution to urban security challenges. By fostering collaboration among diverse stakeholders, including the public sector, private companies, citizens, and academic institutions, the SURE project highlights the value of collective efforts in promoting urban safety. Furthermore, the project underscores the significance of employing the SROI framework as a crucial instrument for assessing public savings and evaluating the impact of urban security technologies.

In this context, the SROI framework serves as a vital tool for providing a comprehensive assessment of the social, economic, and environmental impacts of urban security investments, including the role of technology in shaping urban safety. By adopting a holistic approach that integrates diverse stakeholders and employs rigorous measurement frameworks, cities can effectively evaluate the impact of urban security technologies and ensure the creation of safe and sustainable urban environments. The primary objective of this study was to test the SROI framework with a few indicators. The intention is to conduct more extensive research in the future if the preliminary results demonstrate its potential in the context of urban security investments. The results indicate that the SROI of SURE is 1.2:1, meaning that there is at least a 1.2 euro return on each euro spent. Due to unavailability of data on displacement and deadweight effects and the identified but unaccounted for savings in healthcare and increased security of first responders, we expect that this figure does not depict a complete picture of the project's impact.

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14

Conclusions

Anniina Autero, Marcela de Moraes Batista Simão,
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In conclusion, the pervasive nature of security extends across diverse disciplines, with its roots deeply embedded in the fabric of international relations. From the foundational works of Machiavelli and Hobbes to Foucault and contemporary conceptual explorations, the discourse surrounding security has evolved significantly. This book contributes to this discourse by delving into the expansive realm of security, transcending conventional interpretations, and incorporating emerging technologies and multifaceted perspectives.

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By focusing on smart urban safety, security, and events while also exploring related areas such as surveillance, smart city infrastructure, risk management, and preparedness exercises, the book underscores the complexity and breadth of the subject. Ultimately, it demonstrates that safety and security are not static concepts but rather dynamic constructs that require continuous exploration and adaptation to address the evolving challenges of our interconnected world.

In summary, our exploration throughout the chapters underscores the adaptable nature of urban security challenges and the diverse array of tools and technologies available to address them, catering to different contexts and scenarios to enhance the safety and security of citizens. By balancing theoretical insights with real-world examples, we have provided a comprehensive understanding of security dynamics in both local and international contexts.

Moreover, our approach embraces the fluidity of the security landscape, rejecting rigid definitions in favor of an expansive exploration of interfaces and interconnections. This approach acknowledges the evolving nature of security discourse, exemplified by the Copenhagen School's focus on linguistic processes in shaping perceptions of threats. As a result, issues previously outside the traditional scope of security discourse are now being securitized, broadening the agenda of those responsible for urban safety and security.

In this ever-expanding realm, interdisciplinary collaboration becomes increasingly vital as security concerns encompass a wide range of phenomena, from natural disasters to pandemics, pollution, and terrorism. Traditional/cyber war has also reinstated its status as primary security threat in Europe. By recognizing the interconnectedness of these issues and adopting a holistic approach to security, we can better address the multifaceted challenges facing urban environments and events in the contemporary world.

The integration of technology into security practices demands careful consideration and societal acceptance, particularly in settings such as event venues and public urban spaces. Tampere, like many cities globally, exemplifies the trends of the urban age, with significant investments in infrastructure and leisure facilities. However, alongside these advancements come challenges such as gentrification, which can reshape urban landscapes and communities.

The evolution of technology has profoundly impacted security practices, offering both opportunities and risks. While surveillance technologies raise concerns about privacy and government overreach, they also provide valuable tools for enhancing safety and preventing crime. It is essential to recognize that the neutrality of technology means its effects depend on how it's wielded. Just as nuclear energy can power cities or devastate nations, the Internet can empower voices or perpetuate misinformation.

Similarly, the tools and practices employed in urban security must be evaluated not only for their effectiveness but also for their ethical implications and potential consequences. By adopting a carefully nuanced approach to the coupling of technology and security, we can harness its benefits while mitigating its risks, ultimately creating safer and more inclusive urban environments for all inhabitants.

Finally, our exploration into events and festivals has revealed a common underlying objective: to provide visitors with enjoyable and memorable experiences. Central to this endeavor is ensuring the human security and subjective sense of safety and security within urban spaces. Modern urban planning recognizes the importance of designing cities with the individual in mind, prioritizing sensory experiences and interactions within public spaces. Simultaneously, cities enjoyable to the visitors need to be livable for their local residents.

The security of urban spaces requires collaboration among governmental, regional, private sector, and non-profit entities, supported by modern technological tools. As we have discussed, urban resilience has emerged as a crucial concept in addressing the challenges confronting cities worldwide. In the face of increasingly extreme weather events and natural disasters, the need for resilient urban planning and infrastructure has become more pressing than ever before.

By integrating principles of urban resilience into our planning processes, cities can better adapt to and withstand the impacts of these challenges, ensuring the safety and well-being of their residents and visitors. Moving forward, it is imperative that stakeholders continue to prioritize collaborative efforts and innovative solutions to foster resilient and secure urban environments for all.

Public investments play a crucial role in ensuring the safety and security of people and public spaces; it is imperative to evaluate these investments through the lens of economy, efficiency, effectiveness, and social justice. By incorporating analysis into the evaluation of public investments, decision-makers can make informed choices that prioritize not only financial returns but also social value and equity. This holistic approach ensures that investments effectively meet the needs of communities and contribute to the overall well-being and security of urban environments.

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[1] Note: Page numbers followed by 'n' refer to notes.

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