

Doctoral Thesis in Industrial Economy and Organisation

Critical Infrastructure at the Dawn of a Techno-Organizational Shift: Accountability and Public-Private Governance

LINDY M. NEWLOVE-ERIKSSON



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Abstract

How public-private governance affects accountability for safety in the realm of critical infrastructure is the focus of this doctoral thesis. Case studies of previously under-researched crises and their cascading affects across infrastructures and governance systems, comparative analysis of public-private governance (PPG) of infrastructures such as space and urban rail junctions, and analysis of wider sets of policies and doctrine pertaining to critical infrastructures and their governance are presented.

This work further conceptualizes a contemporary techno-organizational shift, observed increasingly in mixed and integrated public-private structures and evident not only in governance, but in infrastructures themselves (seen for example in development of dual use-satellites, and in urban rail interchanges combining public transportation with consumption and leisure). Moreover, this thesis develops the concept of “patchwork PPG”, which aids unpacking the complexity of governance, addressing specifically the blurred boundaries of internal-external, public-private and domestic-international.

It is also found and demonstrated that accountability can be negatively affected when governance is fragmented, particularly when there exists a patchwork of several PPG constellations, with membership and mandate changing over time. Fragmented governance of infrastructural mega-projects has given rise to the misconception that the rise of private authority in terms of ownership and command and control also implies that private actors have attained/maintain accountability. Further, mega-projects entail lengthy timeframes, implying a loss of continuity and institutional memory, which in turn puts accountability at risk.

I draw on a large multidisciplinary body of past theory and research, including social science crisis research, organizational and governance theory, industrial economics, sociological risk analysis, and science and technology studies (STS). Methodologically, a structured and focused case study approach is employed, building on document analyses and, particularly in one case, personal interviews. Finally, I propose that effective accountability management implies acknowledgment of formal responsibility, that critique is actively and constructively taken on board, and mistakes admitted, without resorting to resignation/s or blame games. Commitment to explorative reflexivity is necessary to truly learn from mistakes, near misses or full-blown crises to implement reform, better tailor preparedness, and allocate resources for responsible management of holistically-viewed infrastructure projects, from conceptual, operational, augmentational through to retirement or reinvention stages.

Keywords: Accountability, Critical Infrastructure, Public-Private Governance, Safety

Sammanfattning

Hur offentlig-privat styrning påverkar ansvarsutkrävande för säkerhet och sårbarhet gällande kritisk infrastruktur står i fokus för denna doktorsavhandling. Avhandlingen består dels av fallstudier av tidigare relativt utforskade kriser och deras kaskadeffekter tvärs över olika typer av infrastruktur och organisatoriska styrsystem. Dels innehåller avhandlingen jämförande analyser av offentlig-privat styrning av infrastruktur såsom satellitsystem och urbana järnvägsstationer. Vidare består avhandlingen av analyser av bredare kontexter för policy och styrning av kritisk infrastruktur.

Avhandlingen bidrar med konceptualisering av ett samtida teknologisk-organisatoriskt skifte som bottenar i integrerade offentlig-privata strukturer och som är påtagligt inte enbart i styrning utan även i infrastrukturen som sådan. Det senare ses exempelvis i utvecklingen av civil-militära satelliter och i urbana järnvägsstationer som kombinerar transporter av människor och gods med konsumtion och nöjesverksamhet såsom restauranger. Avhandlingen bidrar även med ett begrepp som betecknar ”lapptäcken” av offentlig-privat styrning, vilket beaktar komplexitet i organisationsnätverk och styrning och som tar fasta på hur gränser suddas ut mellan internt och externt, privat och offentligt samt mellan inrikes och utrikes.

I avhandlingen observeras även hur ansvarsutkrävande kan påverkas negativt, i synnerhet då offentlig-privat styrning sker via ”lapptäcken” inom vilka deltagande och mandat förändras över tid. Fragmenterad styrning av så kallade ”megaprojekt” har gett upphov till missuppfattningen att framväxten av privat ägande, styrning och kontroll även innebär att privata aktörer har tagit och fått ansvarsskyldighet. Vidare implicerar ”megaprojekt” långa tidsperioder vilket innebär risk för förlust av kontinuitet och institutionellt minne, vilket i sin tur försvagar ansvarsutkrävande.

Avhandlingen drar nytta av en större mängd tidigare forskning inklusive samhällsvetenskaplig krisforskning, organisations- och styrningsteori, industriell ekonomi, sociologisk riskanalys samt studier av vetenskap och teknik. Metodologiskt tillämpas ansatsen ”strukturerad och fokuserad fallstudie”, som bygger på analys av framförallt offentliga dokument samt för en studie personliga intervjuer. Slutligen påpekas att effektivt ansvarsutkrävande innebär erkännande av formellt ansvar, att kritik aktivt och konstruktivt tas emot och att misstag som begås erkänns utan att det leder till avgång eller försök att skylla ifrån sig. Att behålla ett öppet och reflekterande förhållningssätt är nödvändigt för att på ett genuint sätt lära sig från misstag och kriser för att genomföra reformer, anpassa beredskapsåtgärder samt allokera resurser för ansvarsfull hantering av helheten när det gäller infrastruktur gällande alltifrån planeringsstadier till genomförande, operativ styrning och slutligen avveckling eller förnyelse.

Nyckelord: Ansvarsutkrävande, Kritisk infrastruktur, Offentlig-privat styrning, Säkerhet

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Lindy M. Newlove-Eriksson

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List of Appended Papers

- I. Newlove, Lindy M. (2003) “Public Sector Reform, Electricity Policy, and Crisis Preparedness in New Zealand”, Ch. 2, pp. 21-50, in Lindy M. Newlove, Lina Svedin & Eric K. Stern, *Auckland Unplugged: Coping with Critical Infrastructure Failure* (Lexington Books).
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Table of Contents

Abstract	i
Sammanfattning	ii
Acknowledgements	iii
List of Appended Papers	vi
Other Works by the Author	vii
1 Research Problem	1
2 Aims and Research Questions	3
3 Past Research and Key Concepts	5
3.1 <i>Accountability</i>	5
3.2 <i>Critical infrastructure</i>	10
3.3 <i>Public-private governance</i>	13
3.4 <i>Connecting the dots</i>	19
4 Research Design	23
4.1 <i>Research process</i>	24
4.2 <i>Case study methodology</i>	26
4.3 <i>Methods and materials</i>	29
5 Appended Paper Summaries and Contributions	31
5.1 <i>Paper I</i>	31
5.2 <i>Paper II</i>	34
5.3 <i>Paper III</i>	35
5.4 <i>Paper IV</i>	36
5.5 <i>Paper V</i>	38
5.6 <i>Connection and contribution of the papers</i>	40
6 Conclusion	42
6.1 <i>Summary of results and contributions</i>	43
6.2 <i>Recommendations for further research, and policy</i>	49
References	53
Table 1: Paper Summaries and Contributions	41

1 Research Problem

Without infrastructure, society to which we have become reliant upon and accustomed cannot function. Roads, harbors, airports, the provision of electricity, water and sewerage, financial systems, health care, and government are essential for the functioning of post-industrial society. Telecommunications and high-speed Internet have long since been added to these essential services. Notably, all of these functions are increasingly being integrated and interconnected in public-private infrastructures, both in a technical and organizational sense. This can be exemplified by the distribution of electricity – without which modern infrastructure and society would suffer greatly impaired function. Power grids in contemporary society are comprised of a complex network of private and public providers, distributors and regulators of electricity – serving an equally complex network of critical infrastructures, and public and private consumers (Newlove, Stern, and Svedin, 2003). Moreover, the interconnectedness and interdependence of contemporary infrastructures not only facilitates speedy exchange of data and information, but also means that a breakdown in or an attack on one particular infrastructure (e.g. a power station) can have cascading effects across many other infrastructures (hospitals, railroads, air traffic, etc.) (cf. Perrow, 1999; Pescaroli and Alexander, 2016; Little, 2002; Liu et al., 2017; Lam and Tai, 2018).

Arguably, this development can be viewed as a major technological and organizational shift, which implies a leap beyond the shift from industrial society to information society (Newlove-Eriksson and Eriksson, 2021; Dunn-Cavelty and Wenger, 2022). The new post-millennium shift, which has been called “the fourth industrial revolution” (Schwab 2018), is different from past “revolutions” in a qualitative as well as quantitative sense (cf. Perez, 2009; Caselli, 1999). Qualitatively, the new shift implies not only complex interdependence and connectivity of critical infrastructures and public services and functions, but also integration of public and private governance, with largely under-researched consequences. Quantitatively, the shift allows a much wider integration and exchange of data and information than previously possible, through the explosive development of so-called “big data” and “next generation” or “5G” networks and satellite-based communications, which allow for the massive development of embedded and ubiquitous interconnected

technologies in for example the “Internet of Things” (IoT) and “Artificial Intelligence (AI) on demand”.

What this groundbreaking shift implies, in particular how it shapes conditions for accountability and governance of critical infrastructure, is at the core of this doctoral thesis. Importantly, the techno-organizational shift is understood here as a contextual background factor, shaping general parameters for governance and public accountability. By contrast, public-private governance (PPG) is more directly related to accountability, as accountability is coupled to key stakeholders within a governance structure. The techno-organizational shift as defined herein is the increasing integration and interconnectedness of public-private infrastructures, both in a technical and organizational sense. Arguably, the observed shift is driven both by politically initiated efforts to establish PPG of critical infrastructure, and by the physical and digital integration of infrastructures and services, both of which are driven by economic and security concerns.

Past research offers limited insight into how accountability in safety management of infrastructure is affected by public-private governance. Existing research on this topic is scattered across disciplines, has documented rather tentative observations, and is not in agreement about the nature of consequences in terms of safety and accountability. As demonstrated in the review section below, past research tends to fall into one of two main camps – a techno-optimistic “liberal” approach which emphasizes increasing efficiency and economic gain while scantily addressing problems of safety or accountability, or a more techno-pessimistic “critical” approach arguing that the techno-organizational shift has a widely negative impact on safety, private integrity, and democratic accountability. While some scholars have offered more nuanced perspectives (Bossong, 2014; Bovis, 2015; Mörth, 2007), there remains a lack of studies that more systematically observe how and under what conditions safety and accountability are affected by public-private governance, particularly against the backdrop of the current major techno-organizational shift. Arguably, the impact of public-private forms of governance under conditions of increased infrastructural connectivity are not necessarily everywhere the same. It matters enormously how connectivity is designed, by whom, for what purposes, and in what issue-areas. In order to clarify how and under what conditions public-private forms of governance impact on safety and accountability, my thesis presents a series of empirical case studies, informed

by past theory and research, which, when reflected and drawn upon contribute to theory-building on governance and accountability at the dawn of a major technological and organizational shift.

This introduction is structured such that the aims and research questions are first presented. This is followed by a longer section on past research and key analytical concepts, beginning with a review of three bodies of research literature – accountability; critical infrastructure; and public-private governance. Thereafter a discussion of how these phenomena hang together is conducted. This contextual section also clarifies how the key analytical concepts of my thesis are defined and applied. Subsequently the research design is presented, beginning with a discussion of how the five papers came about, followed by an elaboration of the methodological approach and specific methods and materials utilized herein. Subsequently, the content of the five papers are summarized, followed by a discussion of the contributions the papers make with regard to understanding how and under what conditions accountability in public-private governance is affected. The concluding chapter summarizes the answers given to the research questions, relates findings and contributions to past theory and research, and offers recommendations for further research, and policy.

2 Aims and Research Questions

The aim of this doctoral thesis is threefold. Empirically, it aims to contribute knowledge about previously under-researched cases of public-private governance of critical infrastructure protection. I achieve this through case studies of crises and their cascading affects across infrastructures and governance systems (Paper 1 and 3); comparative analysis of public-private governance of particular infrastructures such as space (Paper 2) and urban rail junctions (Paper 4); and analysis of wider sets of policies and doctrines with respect to critical infrastructure and their governance (Paper 5).

My thesis further aims to contribute evidence and interpretations about how and under what conditions accountability in safety management of critical infrastructure is affected by public-private governance. This analysis draws on a multidisciplinary body of past theory and research, including social science crisis research, organizational and

governance theory, industrial economics, sociological risk analysis, and science and technology studies (STS).

Conceptually, my work aims to contribute by identifying key elements of the observed general techno-organizational shift, with focus on interdependencies and cascading effects. The techno-organizational shift is considered as a wider context, which the more specific empirical and theoretical contributions help make sense of. The following research questions are addressed to help meet the aims of the thesis:

- What safety, security and interdependence issues are associated with critical infrastructure, and how are these issues managed?
- How is critical infrastructure organized and governed, particularly with respect to public and private-sector actors?
- How can accountability in safety management of critical infrastructure manifest in times of crises, as well as in periods unmarked by significant undesirable events?

Further, the theoretical objective is that which best clarifies the *explanandum* and the *explanans* of my thesis, that is what phenomena is to be explained or made sense of (explanandum), and what phenomena might explain or make sense of this (explanans). Thus, the explanandum herein concerns safety and public accountability with regard to critical infrastructures and the explanans – i.e. what helps explain it – is public-private forms of governance, with the techno-organizational shift as a general bearing contextual factor.¹ The papers included in this thesis further identify both variety with respect to forms of public-private governance (with emphasis on increasing complexity and what I refer to as patchwork governance), and a number of “intervening” variables. The significance of timeframes is an example of a specific “intervening” variable observed herein, i.e. shorter more acute crisis episodes as opposed to the longer more extended timeframes typical in critical infrastructure development. In order to conduct research on these relations and processes however, it is first necessary to define the key analytical concepts (accountability;

¹ Terms such as explanandum, explanans, and variables applied herein are *not* equated with a unidirectional, linear or statistical understanding of cause-effect relations, but are rather used as heuristic metaphors; they are useful for simplification and clarification of the basic relations I am interested in (those regarding accountability, critical infrastructure, and public-private governance). I consider relations of cause and effect as contextually dependent, that there is room for equifinality (similar outcomes can come about through different routes, in different contexts), and that analysis seeks to trace processes and suggest conditional rather than statistical generalizations. This “soft explanatory” approach is inspired by George and Bennet (2004; cf. the subsequent research design section herein).

critical infrastructure; and public-private governance) and to review past theory and research on these concepts.

3 Past Research and Key Concepts

This section reviews intersecting and multidisciplinary bodies of literature that are of primary significance for my doctoral thesis. Focus herein is on empirical results and theoretical arguments, as they relate to the aims and questions of my thesis. The main body of literature reviewed herein is that which explicitly deals with public-private governance (PPG) of critical infrastructure (CI), with a particular focus on safety and accountability. The following review unpacks key findings and prevailing perspectives on the topic of research. This section also clarifies definitions of key analytical concepts used in my thesis, beginning with accountability (the “dependent variable”), continuing with critical infrastructure (the “contextual” or domain-defining variable), and public-private governance (the “independent” variable). To a degree, the review draws on observations of past research made in the included five papers, but this section also fills some gaps and makes wider connections between the different fields of research exploring accountability and public-private governance of CI. The review section first discusses accountability (including the related concepts of security and safety), critical infrastructure, and public-private governance in separate sub-sections, and finally addresses research connecting these three fields.

3.1 Accountability

Accountability is a topic that has received growing attention in the Social Sciences, particularly within the field of Public Administration, and in the multidisciplinary field of research on governance. Indeed, some scholars claim it is “the buzzword of modern governance” (Bovens, Goodin and Schillemans, 2014), or even the “über-concept of the twenty-first century” (Flinders, 2014). Accountability is a relational, communicative and power-oriented concept that refers to how persons or organizations (whether public, private or non-profit) are held responsible for their actions and non-actions (Bovens,

Goodin and Schillemans, 2014; Bovens, 1998, 2010; Acar, Guo and Yang, 2008). Accountability exists when actors are perceived to have an obligation to explain or justify their conduct and indeed do so as necessary, and they face consequences depending on how their actions are judged (Bovens, Goodin and Schillemans, 2014; Bovens, 2010; Svedberg Helgesson & Mörth, 2012).

In the multifaceted literature on accountability, most studies have focused on accountability for the achievement of organizational or political goals and purposes, what can be termed as “performance accountability” (Bovens, Goodin and Schillemans, 2014). “Performance accountability” may for example, concern a school’s accountability for ensuring that students reach pre-set goals of knowledge and skills and ultimately graduate (Acar, Guo and Yang, 2008), or that a building project meets deadlines and remains within their established budget.

In my thesis however, a particular form of accountability is in focus, namely accountability that comes into play in relation to disasters, accidents, failures and management of threats and risks. In short, focus is on accountability when things go amiss, or what may be termed accountability in management of safety, security, and crisis (Kuipers and ‘t Hart, 2014; Newlove-Eriksson, 2020). More specifically, the present thesis is focused on accountability in safety management of “critical infrastructures”, a concept elaborated upon in the subsequent section.

Given the focus on accountability for safety and security, the latter concepts also need to be addressed. Safety is understood here not only as the preservation of human life and health, but is also about personal integrity and feelings of comfort (Dragu, Roman, & Roman, 2013). More formally, safety herein is regarded as the ability to optimally manage and minimize risk, which in terms of active measures has been termed “safety work” (Sandberg, 2016). Ongoing vigilant safety work is integral to the building, operation, maintenance and renovation of critical infrastructures as they are to a high degree “safety critical” systems, i.e. systems in which problems can result in injuries, deaths, or environmental crises (cf. Storey, 1996). Safety critical systems are becoming increasingly complex with hardware and software developments, applications of machine learning, extrapolations and linking of systems; engineers point to the challenge of inherent errors which are exceedingly difficult to overcome as a result of increasing technological

complexity and miniaturization (Mueller-Gritschneider et al, 2021: 249), combined with accompanying demands for cost reduction (Kühn et al, 2021: 121). In accordance with the literature, risk is defined herein both in terms of probability and consequences, i.e. as the perceived likelihood of loss, accident, or other unfortunate incidents as well as concerning the magnitude of the consequences of failure (Dinmohammadi et al, 2016).

Security moreover, has become its own subject matter – Security Studies, which is a sub-discipline of International Relations. In this field, two general and widely shared observations have been made (cf. Buzan, 1991/2007). First, security is an “essentially contested concept”, particularly with respect to whether security should be applied broadly to incorporate for example ecological, economic and societal security (as has become the case in many national security strategies since the end of the Cold War) or if security only concerns military or serious gray zone threats, with the sovereign state in focus. Second, despite its contested nature, most definitions agree with a definition of security as “freedom from threat”, whether threats are more or less objective or perceived. In the remainder of my thesis, the terms safety, security and risk do not play a key analytical role, but are mainly used in relation to the key concepts of accountability and critical infrastructure.

Accountability is frequently perceived as a burden on people and organizations, expressed in terms of answerability, liability, and blameworthiness. Hence it is not surprising that when accountability is called for – through for example political elections, performance reviews, or in response to catastrophic events – people and organizations may look for ways to distribute the burden or escape it altogether. Contracts, standards, chains of command, and formal roles and responsibilities might make the allocation of accountability seem obvious, but so-called “blame games” may nevertheless be initiated as outcomes can be complex and hard to interpret. “Blame games” are politicized, bureaucratic, or judicial conflicts over accountability and responsibility for events (Hood, 2014; Schedler, 1999). Actors involved in blame games typically seek to allocate accountability to others than themselves, or claim that accountability has not been determined, and they are thus not responsible. Blame games imply efforts to avoid political, legal or financial costs associated with accountability for a perceived crisis, policy fiasco or management failure (Bovens and ‘t Hart, 1998). Blame games can be played out both as conflict regarding overall accountability, or as accountability for a specific aspect of an

outcome, concerning for example causes of the unwanted outcome, problem management (operative and political), oversight, and financial responsibility.

Blame games may occur regardless of what kind of accountability is at stake, yet it can be assumed to be particularly salient when it concerns accountability for safety, security or disaster management (Kuipers and 't Hart, 2014). When lives are lost or infrastructure is destroyed, blame games can get particularly tense. This is empirically demonstrated in past research on public crisis management, which shows that blame games are difficult to avoid in situations where actors seek to avoid political and/or financial attribution and repercussions (Kuipers and 't Hart, 2014; Hood, 2014; Bovens, 2010; Boin et al, 2016; Boin, McConnel and 't Hart, 2008). Within this field of research, it has been observed that there are rarely incentives to organize accountability before major incidents have occurred, and post-crisis learning is also riddled with difficulties that may but do not necessarily lead to improved safety (Kuipers and 't Hart, 2014; Hood, 2014; Boin et al, 2005: 112).

Arguably, accountability processes are becoming yet more problematic due to the development and use of social media facilitating a more aggressive approach to leaders (Boin, McConnel and 't Hart, 2008), in for example populist “truth fabrication”. This – as well as comparatively innocuous ignorance – is also related to the fact that the public are increasingly unapprised and thus unaware of the complex technological and contractual apparatuses governing crisis-vulnerable infrastructures, often in interconnected, ICT-dependent “embedded” forms that are physically as well as politically distanced (Newlove-Eriksson and Eriksson, 2013: 285-286).

Due to the explicit combination of public and private actors in PPPs, where interests do not necessarily converge, “blame games” may be particularly hard to avoid when problems arise, criticism ensues and responses towards the public are expected. Indeed, past research demonstrates that the “accountability arena” successively involves more and more stakeholders, making it increasingly difficult for “leaders to emerge as winners in these blame games” (Boin, McConnel and 't Hart, 2008:12). PPPs typically lack a clear hierarchy and lines of responsibility and are more prone to a high degree of change in “projects” or “stages” that are not centrally or holistically documented or aligned over time. Indeed, a core notion of PPP is to operate in fluid and network-based patterns, arguably maximizing efficiency and avoiding bureaucratic “silo” modes of operation.

How then can the often prickly concept and practice of accountability be made more coherent and useful? Mark Bovens suggests a distinction be made between accountability as virtue and as mechanism, both of which are present and important in modern society (Bovens, 2010). Accountability as virtue means that actors are capable of self-control and consciously consider themselves responsible for the consequences of their actions. This is similar to what other scholars have termed “accountability as managing expectations”, which allows for public agencies and other actors to have a clear role in identifying and managing expectations of their actions (Acar, Gou and Yang, 2008: 6). Accountability as virtue implies trust on behalf of possibly multiple stakeholders (including the general public), the existence of an ethical or professional code, and a level of discretion in terms of what the agent can do, and in which manner.

Accountability as mechanism by contrast, implies a strict “principal-agent” relationship in which the “principal” (e.g. the national government) oversees and controls that public agencies accomplish goals set by the “principal”, and that they comply with prescribed rules and regulations (cf. Gailmard, 2014). Accountability as mechanism is similar to what other scholars have called “accountability as answerability” (Acar, Guo and Yang, 2008: 5). Accountability mechanisms can be further categorized in terms of what kind of relationship is implied between actors assigning and receiving demands of accountability, i.e. imposing costs on incumbents. Lührmann et al (2020) suggest a distinction between “horizontal”, “vertical”, and “diagonal” accountability mechanisms. This is a useful conceptualization of the power dynamics in accountability processes, yet the specific types of mechanisms they address concern accountability in democratic political institutions rather than governance of infrastructure. Hence, while Lührmann et al (2020) address parliamentary and judicial oversight as “horizontal” accountability mechanisms (i.e. constraints among equals), I suggest that with respect to public-private partnerships, “horizontal” accountability mechanisms can for example be performance reviews, contractual negotiations, auditing, and via the perhaps more irregular occurrence of whistleblowing from within public-private partnerships.

Whereas “vertical” accountability mechanisms in democratic institutions refer to electoral competition between and within political parties, I suggest that with respect to public-private partnerships, vertical accountability may refer to appeals, court reviews and

governmental commissions of inquiry, as legitimate public-private partnerships ultimately depend on public oversight (cf. Stafford and Stapleton, 2017). Finally, “diagonal” accountability mechanisms in democratic institutions refer to pressures from civil society and the media, pressure which also applies to public-private partnerships for infrastructure. Watchdog journalism is an example of such a “diagonal” accountability mechanism (cf. Lürmann et al, 2020; cf. Bovens, Goodin and Schillemans, 2014).

In sum, accountability is the explanandum in my thesis, and it is noted that the concept is distinctively relational, communicative and power-oriented. As shown by past research, accountability in general and with respect to safety and crisis management in particular may lead to infected blame games. Arguably, such blame games can play out both in terms of (broken) trust and as violations of accountability mechanisms. The ensuing papers, which together with this overarching essay comprise my thesis, demonstrate in more detail how accountability becomes significant in particular cases, how it is approached by key actors, and what repercussions may follow when accountability is deemed insufficiently or inappropriately addressed.

3.2 Critical infrastructure

The notion of “critical infrastructure” emerged from a political rather than academic context. It first appeared in the United States in the mid-1990s, most notably with the Presidential Commission on Critical Infrastructure Protection (PCCIP), which delivered an oft-cited report in 1997 (Dunn and Wigert, 2004: 18; Aradau, 2010: 500). The PCCIP emphasized how states, economies and societies around the world had become interdependent, and that vulnerability was shared across borders, particularly through the development of transboundary financial, energy, and communications systems. The concept of “critical infrastructure” has since been adopted in policy and technical expert communities globally, and is also explicitly employed in much legislation and policy-making. “Critical infrastructure” is often abbreviated CI, and also relates to efforts to secure such infrastructures, the practice of which is labelled “critical infrastructure protection” (CIP). A variant acronym and practice is CIIP, which refers to “critical *information* infrastructure protection”, i.e. information and communications technology (ICT) infrastructure, such as

fiber optic broadband networks, cellular bandwidth networks (e.g. 5G), and satellite communications (Dunn and Wiegert 2004; Dunn, 2005; Newlove-Eriksson, Giacomello and Eriksson, 2018).

How then, can “critical infrastructure” be defined? In both a policy-oriented and academic or theoretical sense, the concept tends to be used rather straightforwardly as referring to infrastructures considered of particular significance for the function or even survival of modern society. Notably, “critical infrastructure” refers to material objects such as nuclear power plants and airports, but the concept also signals the significance of material objects for the security of people and community (Aradau, 2010: 509). Of increasing significance are quasi-material and ethereal dimensions of critical infrastructure, such as that provided through and operating in conjunction with “cloud computing”. The concept of critical infrastructure is closely related to notions of national security, societal resilience, and (civil) defence, understood in a wider and more comprehensive sense than the traditional concept of military security. Past research has also shown how novel terms have entered this policy field, such as “resilience” (Chmutina et al, 2016), which typically emphasizes how state and society can deal with modern risks and vulnerabilities, rather than on infrastructures per se, although the inverse is also evident.

There is considerable variation in how general definitions of critical infrastructure are applied however, i.e. what particular infrastructures are given the status of “critical” (Dunn and Wiegert, 2005). Some analysts have directed their efforts at specifying objective criteria of “criticality”, distinguishing between failures with limited impact (e.g. shutdown of a local transport system) and intense impacts implying widespread destruction and mortality (e.g. nuclear fallout, pandemics, severe climate change effects) (Egan, 2007: 10-13). The bulk of social science contributions however, address how the concept of “critical infrastructure” is the subject of political and bureaucratic struggles. Depending on what infrastructures are officially listed as “critical”, and “safety critical”, different “relevant” stakeholders are brought to the fore, potentially leading to turf battles and the opening or closing of market opportunities. Past research, informed by critical theory and discourse analysis, has suggested that the labelling of something as “critical infrastructure” is a certain type of “speech act” – a “securitizing move” – designating particular infrastructures as prioritized in the national security context (Aradau, 2010: 501; Dunn, 2005; Newlove-Eriksson, 2020).

Political debates have taken place in for example the UK and on the EU level about which infrastructures should be categorized as “critical”, for example making distinctions between the security of nuclear power (deemed “critical”) and delivery of drinking water and sewerage in communities, the latter allegedly deemed less “critical” (Aradau, 2010: 506). Past research has also demonstrated that political struggles can ensue regarding whether “critical infrastructure” is to be designated a “national” or shared “European” responsibility (Aradau, 2010: 505). Current pan-European efforts at establishing “critical entities” will likely further extend geo-political and critical infrastructure classification (European Commission, 2020).

Moreover, not only are there both differences and similarities between the usage of the concept of critical infrastructure in different states and regions – past research has shown that the designation is susceptible to change. In general, the list of “critical infrastructures” tends to get longer over time (Egan, 2007), as is witnessed in for example the European Union. The concept of CIP within the EU was first introduced following the “9/11” attacks in the US in 2001, and cemented after the March 11, 2004 terrorist attacks in Madrid. Since then, the EU list of critical infrastructures has been expanded, and the possibility for future additions to the list made explicit (EPCIP 2007; European Commission, 2004; Van Asselt, Vos and Wildhaber 2015; Bossong 2014; Pursiainen 2009). A noteworthy example is the inclusion of space infrastructure – particularly satellite systems – on the EU list of “critical infrastructures” (Newlove-Eriksson, 2019). In 2006, the European Commission listed eleven sectors as “European Critical Infrastructures”: Energy; Nuclear Industry; Information and Communication Technologies (ICTs); Water; Food; Health; Financial; Transport; Chemical Industry; Space; and Research Facilities, with more detailed sub-sectors identified (European Commission, 2006: 21).

“Critical infrastructure” has become the focus of a wider range of technical research and development, most of which is focused on identifying and managing risks and vulnerabilities. The list of such dangers is comprehensive, often categorized in terms of both internal and external “faults”, including malicious attacks such as computer hacking and the detonation of explosives, “natural” phenomena such as power outages and flooding, and human errors such as construction flaws and system “bugs”. Ideational or

immaterial phenomena are also occasionally addressed, such as (the lack of) trust, rules and regulations, and procedures for making decisions and policies (Alcaraz and Zeadally, 2015).

Social science research on “critical infrastructure” has rather tackled the political and bureaucratic struggles of defining infrastructures as “critical”, as noted above (Aradau, 2010; Dunn, 2005; Newlove-Eriksson, 2019). Moreover, social science contributions have critiqued the tendency to focus on materiality and infrastructure as such, rather than on the societal functions and services they serve (Dunn, 2005: 266). Similarly, earlier tendencies among practitioners and technical experts to focus on “sectors”, and particularly on one “sector” at a time, has been criticized in that interdependencies across sectors can thus be neglected (Dunn, 2005: 264). However, over time the significance of cross-sectoral interdependencies and “cascading effects” have been increasingly brought in focus in technical studies as well (Heracleous et al, 2017; Lam and Tai, 2018; Pescaroli and Alexander, 2016). This newer norm also corroborates my observation herein of a wider techno-organizational shift implying increased connectivity across infrastructures and services – referred to in innovative engineering as “collaborative embedded systems (CES)” (Böhm, et al, 2021:16) something that has become much harder to oversee and control for individual stakeholders and regulatory networks and bodies alike. Thus, this subject is as highly pertinent for social science as it is for advanced systems engineering (ASE), arguably more so if technological development is not seen as an end in and of itself but rather – as democratic government is – a servant of the people.

3.3 Public-private governance

Having discussed past research on accountability and “critical infrastructures” as politically prioritized material objects associated with particular societal functions and services, the present section moves on to discuss past research on how these infrastructures are governed. This is a crucial step, as it is the link between accountability and governance that constitutes the core of my scholarly endeavor.

As noted, this thesis is mainly concerned with mixed forms of governance, or more specifically various forms of public-private governance, what is abbreviated here as PPG. This kind of mixed governance is often referred to as public-private partnership, PPP. For

two reasons, however, I find it more appropriate to use the label governance rather than partnership. First, “governance” is a more encompassing term than “partnership” (cf. Schomaker, 2017; Westerwinter, 2019), and a broader term is essential for capturing a broader variety of governance networks and “partnerships”. Second, the term “partnership” has strongly positive connotations, implying if not agreement, certainly alliance over some shared values and common priorities. Such an inherent etymological and discursive bias is less conducive for an objectively geared analytical approach, which may in fact reveal how combined governance is characterized by agreement as well as disagreement, shared as well as conflicting values, and smooth operation as well as tension, rivalry and conflict. Indeed, as noted by Hodge, Greve and Biygautane (2018: 1106), “the adoption of the phrase ‘public-private partnership (PPP) instead of simply ‘private finance’ deals [initiatives] was a masterstroke of positive policy language.” It might be argued that the concept of governance can also convey certain positive connotations, particularly if used to advocate “governance” as something informal, network-based, and supposedly non-hierarchical – and therefore normatively superior to hard and hierarchical “government” (Peters & Pierre, 1998; Rosenau & Czempiel, 1992). While it is challenging to locate virtually any analytical concept completely free from normative connotations or that has not at some time been an object of politicization, I nonetheless find the concept of governance unbiased and fit for encompassing a possible continuum of neutral to amicable and adversarial relations as opposed to the more limited notion of partnership. Prior to discussing the concept of public-private governance (PPG) and past research, the concept of governance applied herein warrants definition.

Governance refers to “all processes of governing, whether undertaken by a government, market, or network, whether over a family, tribe, formal or informal organization, or territory, and whether through laws, norms, power or language. Governance differs from government in that it focuses less on the state and its institutions and more on social practices and activities” (Bevir, 2012: 1). This definition is sufficiently broadly applicable and also builds on the wider literature on governance (cf. Peters & Pierre, 2006). This definition also serves the purpose of my thesis by capturing complexity and variability evident in mixed forms of PPG.

Of relevance too is the notion of governance *structure*, referring herein to which public and private organizations and procedures are involved in building, managing, and operating infrastructural megaprojects (Sanderson, 2012). Thus it is networks of (public and private) organizations that are in focus here (Provan & Kennis, 2008), rather than the internal makeup of individual participating organizations.

What then, does the concept of PPG entail? First, as noted, the literature on this topic mainly uses the term public-private partnership, sometimes abbreviated as PPP or P3. Second, while there are a number of definitions circulating in this multi-disciplinary literature, the following definition of PPP by Hodge and Greve is one of the more oft-cited, and also guides the present work: “cooperative institutional arrangements between public and private sector actors” (Hodge & Greve, 2007: 54). This is a broad and generally applicable definition, which allows for and incorporates diversity, complexity and change among and within mixed forms of governance.

Some scholars reserve the concept of PPP for contract-based partnerships between clearly identified public and private organizations (Hayllar & Wettenhall, 2010). Wider PPPs are not always defined as such by participating actors themselves, who may rather identify themselves as parties to looser “networks” and “strategic alliances” (Acar, Guo, & Yang, 2008; Bexell & Mörth, 2010; Hoon Kwak, Chic, & Ibbs, 2009; Erie, Kogan & MacKenzie, 2010, pp. 646647; Verweij, Teisman, & Gerrits, 2017). My broader understanding allows conceptualization of both the wider PPG structure of infrastructural megaprojects, as well as more specific and contract-based public–private constellations. As noted by leading scholars in this field, “the phrase PPP has been used across several families of activities ranging from health services and joint venture companies to the delivery of public infrastructure” (Hodge, Greve and Biygautane, 2018: 1105). However, the scope is not limitless herein, but is focused on PPG of critical infrastructure (cf. Hodge, Greve & Biygautane, 2018; Hodge et al., 2010; Hoon Kwak et al., 2009; Little, 2011).

My preference for the concept of governance over partnership as an analytical term is further bolstered given the common underlying assumption in the PPG literature that “intense cooperation between public and private actors in stable long-term contractual relations logically leads to better and more innovative services and policy outputs at lower costs” (Hodge, Gere and Biygautane, 2018: 1114; Ghobadian et al., 2004). Beyond this

relatively widespread assumption however, past research on the topic is decidedly diverse, in terms of what disciplines are involved (and thus which questions are asked), and in terms of empirical cases and findings, as well as in terms of theoretical and normative interpretations. In a 2018 review of the field of PPG studies, several noteworthy observations are made with respect to how the field has developed (Hodge, Greve and Biygautane, 2018; cf. Hodge and Greve, 2007; Wang et al, 2017).

First, it is noted that PPP emerged as a conceptual tool for policy reform in the UK and Australia in the early 1990s – variously referred to as Private Finance Initiative (PFI) – and then quickly disseminated across Europe and North America. PPG has been marketed as a method for increasing efficiency and delivery of public infrastructure. At the same time, PPG provides access to private finance for public infrastructure – typically large-scale projects for which private business might be reluctant to take on any major financial, management or long-term role. In short, PPG is often believed to be a method for overcoming both “government failure” (low efficiency, high costs) and “market failure” (unequal distribution of infrastructure) (Hoon Kwak et al, 2009: 52).

Over the past three decades, “PPP” became a concept and practice adopted globally, including new transnational PPG constellations and several international organizations adopting PPP and PFI strategies such as the World Bank, the OECD, ASEAN, and the Asian Development Bank (Bexell and Mörth, 2010; Schomaker, 2017; Westerwinter, 2019). Global dispersion of “PPP” language and the associated “delivery of infrastructure” notion has also meant increasing diversity. PPG is certainly not everywhere the same. An example of PPG diversity is found in application of the concept of public-private partnership not only in liberal democracies, but in autocratic countries as well, and in different ways in both. In China for example, private partners are wary of government intervention, which is typically considered a “major risk” (Ke, Wang and Chan, 2013). Alternatively, some PPG constellations in China are more “publicly” than “privately” governed given that many domestic “private” partners are state-owned companies.

Second, past research has to a large degree focused on the performance of PPG: Why and how do public-private governance undertakings “work” or “fail”? There is no straightforward or consensual answer found in the literature however, which is partly a result of how differently the notion of “success” is understood. For some analysts, success

is measured in terms of “project delivery”, that is whether public-private governed infrastructure actually delivers the promised infrastructure, that the constellations do so on time, that budgetary limits are not exceeded, and that, where present, contracts are held intact. Other observers however, apply a wider understanding of success, bringing the development of lasting relationships and new institutional frameworks into the analysis (Hodge, Greve and Biygauntane, 2018: 1114; Jeffares, Sullivan and Bovaird, 2013).

Whether performance is defined by project delivery or more broadly in terms of development and depth of collaboration, there are some commonly made observations on which key factors matter. Broadly speaking, these “independent” or “intervening” variables can be categorized as “hard” (contracts, output and financial criteria, and penalties) and “soft” (management, organizational culture, and trust). Economists and legal scholars in particular often emphasize the “hard” factors of how contracts are written up, financial control, project delivery, and penalties (cf. Jeffares, Sullivan and Boivard, 2013). Other studies - in particular within public administration, policy studies, political science and parts of business administration - emphasize “governance”, “organization” or “management”. One study of PPG performance provocatively asserts: “it’s the management stupid!” (Klijn, 2008), emphasizing that the quality of management practices matter more than organizational structure and contracts. Yet other studies suggest that it is the combination of management and organization that ultimately determines the performance of PPG (Soeipto and Verhoest, 2018).

Finally, some studies underscore trust as the most significant factor in ascertaining performance of PPG (Warsen et al., 2018). Whereas trust has been succinctly defined as the “belief of one agent in the capabilities and future actions of another agent”, enabling trustor/s to relinquish control to trustee/s, and facing “negative consequences if the trustee does not perform as expected” – i.e. accountability – trust in for example highly complex embedded systems is necessitated in numerous functions, involving non-human as well as human trustees (Akili, et al, 2021: 218). Trust takes time to build in relations and into systems, and is easily damaged when participants – or systems – fail to meet up to expectations or violate agreements or contracts. Ironically, so-called “[t]echnologies of distrust, such as auditing, have also been found to assist in sustaining collaborative relationships” in PPG megaprojects (Klakegg et al, 2020: 289). Notably, there is a large

body of research on trust as a core feature in studies of governance and “good government” more generally, which is arguably of relevance for understanding the performance of PPG as well (Rothstein and Stolle, 2008).

For the purpose of this present work, both “hard” and “soft” factors impacting on the performance of PPG will be considered, but to a different degree and in somewhat different ways in each of the papers included. Notwithstanding, the common focus is accountability (a crucial component of performance) in critical infrastructure constellations applying PPG.

There is a strand of PPG research that has dealt specifically with accountability, particularly within public administration and political science. This research has studied how accountability is and isn’t addressed when disasters occur, when PPG projects are cancelled, or when they are underperforming. “Performance accountability” (see the preceding accountability section) appears relatively common in PPG studies, particularly within management and economic research. As noted however, my thesis is concerned with accountability in PPG in relation to safety, security, and crises – which goes beyond everyday economic or production performance accountability (Kuipers and ‘t Hart, 2014).

Past research highlights the generic accountability weakness of PPG; as constellations applying this governance structure comprise both public and private stakeholders, with different incentives and legal statuses, there is an inherent risk that PPG actors will seek to blame each other when things go awry (Kuipers and ‘t Hart, 2014; Boin, McConnel and ‘t Hart, 2008; Newlove-Eriksson, 2020). With more stakeholders involved, governance becomes more complex, including the assignment of accountability. Importantly, this does not mean that either purely public or private governance is in any general sense superior to the other. The observation here is simply that a mix of fundamentally different types of participants more easily leads to accountability problems than more homogeneous governance structures. Examples of specific challenges for accountability in PPG are that managers typically do not have hierarchical control over partners, mandates and discretionary powers differ, different stakes are at play, many participate on a voluntary basis, and many partnerships are temporary (Acar, Guo and Yang, 2008: 7).

The PPG literature has, as indicated, also highlighted the difference between accountability as “virtue” and as “mechanism” (Acar, Guo and Yang, 2008: 5-6; Bovens,

2010). Whereas the former is, as earlier mentioned, about management of expectations and is closely related to trust building, the latter is related to performance reporting, auditing, and general answerability to critique. Both types of accountability are of relevance in studies of PPG, as in studies of governance in general. It can be noted however, that there is a tendency to emphasize the significance of contracts for management of accountability in PPG constellations, and for risk management in general (cf. Jeffares, Sullivan and Boivard, 2013). This implies clarification of the roles and responsibilities of PPG participants in written contracts, and ensuring contracts are revised accordingly when participants and objectives change. Importantly, Soeipto and Verhoest (2018) found that renegotiation of PPG contracts is common, providing a figure of 40-75 percent of cases from their European survey demonstrating renegotiation. Blame is not necessarily assigned to members of PPG constellations, however. During the global financial crisis that peaked in 2008, many PPG constellations underperformed or were dissolved (Hodge, Greve and Biygauntane, 2018). In such circumstances, it was in some cases easier to blame the external crisis rather than fellow stakeholder parties.

3.4 Connecting the dots

Having discussed the three key concepts and related literatures on accountability, critical infrastructure and public-private governance, this final review section looks specifically at how past research has addressed how these three phenomena are related. In essence, what is the state of the art of research on how PPG of critical infrastructure affects accountability?

While PPG has been heralded as a “revolution” for development of public infrastructure (Grimsey and Lewis, 2004), results in terms of both efficiency and accountability have been mixed at best (Forrer, et al, 2010; Hodge and Greve, 2007; Stafford and Stapleton, 2017). Public and private actors involved in Critical Information Infrastructure (CII) struggle not only with technological reliability, but also with securing long-term investments, and with how to make ICTs and CII resilient (Newlove-Eriksson, Giacomello and Eriksson, 2018; Wettenhall, 2003).

Organizational theories suggest that *institutional fragmentation* – i.e. too many stakeholders – negatively affects the ability to reliably manage critical infrastructures, with possible catastrophic consequences (Perrow, 1999). Public-private forms of governance are impaired by general accountability weaknesses, in comparison with more homogenous and linear organizations. Combination of public and private actors – with different incentives, mandates and organizational cultures – imply a general risk that public and private stakeholders and variations thereof will blame each other if and when things go amiss. In addition to differing mandates and organizational cultures, constellations employing PPG are often characterized by a lack of hierarchical control, and the fact that many partners participate on a temporary and voluntary basis (Acar, Guo and Yang, 2008: 7); indeed changes in ownership or viability can effectively result in partners removing themselves and their participation in a PPG. Importantly, these features do not imply that either purely private or purely public governance is “better” in terms of performance or management of incidents; many other factors come into play, such as access to resources, timely communication of accurate information, and individual leadership. What past theory and research suggest is essentially that more homogenous governance structures do not have the same kind of general accountability weaknesses as PPG constellations tend to demonstrate.

Further, as critical infrastructure often takes the form of “mega-projects”, this implies an additional accountability weakness. Mega-projects such as the building and management of major airports, harbors and railway intersections imply complexity of governance in specific ways (Flyvbjerg, 2014). There is a greater number and variety of public and private stakeholders, some of which are bound by specific contracts, while others participate in a more informal networked way. Moreover, since mega-projects are long-term efforts, stakeholders tend to come and go, and also change identity and structure within themselves. Such change over time might invalidate original contracts, which is also why many constellations employing PPG tend to renegotiate their contracts. The complex and long-term character of infrastructural mega-projects also imply challenges for “institutional memory”: who did what; when; why; and how?

Moreover, while past research on the accountability of PPG conglomerations is largely concerned with performance accountability such as timely delivery and avoiding

budget overspending (cf. Hodge, Greve and Biyagautane, 2018), accountability of critical infrastructure is concerned with existential questions – the safety of people, security of infrastructure and public services, and national security in a wider sense (Bovis, 2015; Boin and McConnell, 2007; Dunn, 2005). In other words, the nature of the project matters for how accountability is affected (Murphy, 2008; cf. Wang et al., 2017: 310). Major disruptions of critical infrastructures indeed have serious consequences not only for the public and private actors directly concerned, but also for the well-being and prosperity of possibly millions of people affected. Due attention to security and safety is often found to be lacking in PPG of infrastructures, however (Bailes and Frommelt, 2004; Dunn-Cavelty and Suter, 2009; Newlove, Giacomello and Eriksson, 2018). One study concludes that “current CIP-efforts seem very vulnerable in the light of institutional fragmentation and networked forms of reliability” (de Bruijne and van Eeten, 2007: 25).

In order to grasp the safety and security problems of highly integrated critical infrastructures, the sociological literature on “modern risks” is instructive, in particular Ulrich Beck’s notion of “risk society”, and Charles Perrow’s concept of “normal accidents”. Both researchers made the observation that modern industrial society is becoming increasingly complex, so that with each technological innovation and increasing societal reliance on it (e.g. nuclear power), the risk of unintended accidents and catastrophes increases (Beck, 1992; Perrow, 1999). In addition, with increasing interconnectedness of critical infrastructures, there is an increasing risk of cascading affects, which includes but is not limited to the spread of digital plagues (“viruses”, “worms” and other such malign phenomena). Current engineering expertise points to further inherent – i.e. essentially unavoidable – failures brought upon by increasing complexity in construction and operation of miniaturized hardware and software, and increased connectivity of them (cf. Kühn et al, 2021; Mueller-Gritschneider et al, 2021).

Research on infrastructural crisis incidents shows that in many cases accountability becomes politicized and a major source of contention among PPG participants even if general responsibilities and risk management procedures have been spelled out in contracts or in standard operating procedures (Boin and McConnell, 2007; Boin, McConnel and ‘t Hart, 2008; Bovis, 2015). When disaster strikes, which occasionally occurs in complex and cascading failure prone systems such as critical infrastructures, politicization and blame

games easily follow. Given the public safety and security aspects of critical infrastructure, accountability is particularly prone to politicization and highly charged blame games. As documented in the literature on public crisis management, the unfolding of a major accident or other kind of disaster does not necessarily pull stakeholders and decision-makers together in a unified and consensual effort to deal with the emergency. On the contrary, in many instances crises, particularly when they appear “uncontrollable” or when the loss of lives and infrastructure is considerable, cooperation wanes and blame games follow (Kuipers and t’ Hart, 2014; Boin and McConnel, 2007; Boin, McConnel and t’ Hart, 2008).

Rather than specifying accountability for hazards in contracts, Bovis (2015) suggests that integrating risk-related costs in tariff arrangements may contribute to better risk management, and thus accountability. This is only one among many other approaches, ranging from “hard” legal-contractual approaches to “soft” trust-building efforts (Warsen et al., 2018). More generally, Wang and colleagues highlight the importance of “risk sharing” as a critical element for successful PPG arrangements, but also notes that there is considerable complexity with regard to this: “Institutional stability, regulation environment, and types of project will affect the allocation of risks” (Wang et al., 2017: 305).

There is obviously a lack of consensus on how PPG in critical infrastructure affects accountability. As shown above, the literature is divided on what really matters – ranging from organizational form (formal partnership contracts as opposed to more loosely organized networks and agreements) to management behavior emphasizing dialogue and trust. Some argue that there is one feature that matters above all others, such as management strategies (cf. Klijn, 2008). Most contributions however, especially those based on reviews of the growing PPG literature, suggest that it is not a question of “either/or” but a combination of several factors, including organizational form and management.

How then, do organizational form, management and other factors affect accountability? Again, whereas there is no consensus, some noteworthy contributions have adopted a multi-factor approach. For example, Murphy argues that three variables are of particular significance: (1) the nature of the project itself; (2) that government leads with effective project and contract management skills; and that (3) explicit and effective risk allocation exists (Murphy, 2008; cf. Wang et al., 2017: 310; Svedberg Helgesson & Mörth, 2012; Stafford and Stapleton, 2017). The nature of the infrastructural project may range

from the small and short term (e.g. a bus station) to long-term mega-projects (an international nexus for air, land and sea-bound transport).

The second variable clearly states that if the purpose of the constellation employing PPG is to build and manage public infrastructure, public (governmental) oversight and management skills are essential. This suggests that, at the end of the day, public accountability cannot be outsourced to private actors, even if private actors choose to commit to “corporate social responsibility” (CSR) and judiciously operate services, financing and management (Murphy, 2008; Stafford and Stapleton, 2017). Importantly, past research has observed that private actors often also resist the idea that they would be held accountable for public safety and security (Svedberg-Helgesson & Mörth, 2012; Lund Petersen, 2008: 417; Stafford and Stapleton, 2017), which reinforces the notion of government lead. The Limited Liability Corporation (LLC) form with its’ international corollaries exemplifies this point of departure. Notably, this variable hints at a general public responsibility for accountability: whereas services and management of public infrastructure can be outsourced or shared with private “partners”, accountability in democracies ultimately rests with public authorities.

Murphy’s third variable simply confirms that accountability, in terms of risk management, needs to be addressed explicitly and effectively. The question that begs an answer, and on which there is no consensus, is how can this be achieved? Scouring the PPG and accountability for safety literature reveals an emphasis on both organizational (including contractual) solutions and managerial factors (including dialogue, trust building and observance of standard operating procedures). Crisis management research and risk studies research adds lesson-drawing from exercises and past experience (including vicarious) and application of risk assessment tools (cf. Boin, McConnell and ‘t Hart, 2008).

4 Research Design

This section addresses the research design of my compilation thesis, explains how the papers came about, the basis of case selection, and which methods and sources are applied in the case studies. I begin by discussing my personal research journey, leading to the papers

included herein, and explain how my contributions hang together. I then document the case study approach that guides all five papers, including specific aspects such as application and development of theory, generalization, and issues of validity and reliability. Finally, the specific methods and materials used herein are discussed.

4.1 Research process

The manner in which the five papers included in this compilation thesis came about was not part of an original master plan. The papers have rather been developed separately, through or inspired by experiences in different research projects, and together cover a period of a decade and a half. Importantly, whereas the papers are not as stated, part of an original master plan, they are all nonetheless concerned with the same overarching themes: critical infrastructure; public-private governance; accountability; and safety. Moreover, taken together, the papers provide a set of empirical observations across several cases and over time, as well as conceptual developments and analytical propositions of furthering scholarship on how public-private governance affects accountability and safety regarding critical infrastructure.

As way of background, my interest in the core themes of my thesis developed initially from my education as a Bachelor of Arts student at the University of British Columbia with an Honours in Sociology, and continued with my Master's thesis on comparative nuclear power and nuclear waste, which I wrote as part of the interdisciplinary Master's program in the International Graduate School, IGS at Stockholm University. Upon completion of my Master's thesis, I was employed in a research program on crisis management in the Baltic Sea Region, led by Bengt Sundelius and Eric Stern. In my work within this research program, which evolved into a center for crisis management research and training (Crisis Management Research and Training, CRISMART, affiliated with the Swedish Defence University in Stockholm), I have conducted research and training in crisis management, particularly with respect to critical infrastructure and public accountability, beginning with a study of the Eastern Canadian ice storm of 1998 and subsequent blackout and largescale infrastructural failure and a study of a fatal lift platform collapse in Talsi, Latvia (Hansén and Stern, eds, 2000). To succinctly summarize my personal research journey it has entailed

an interest and engagement in crisis research (and applied research in training) in the areas of critical infrastructure, transitional states, command and control, standardization (of among other things symbology), and psychosocial support and ethics in crisis management (Dückers et al, 2018).

The empirical phenomena studied in my present Doctoral thesis are the public-private management of the Auckland electricity outage of 1998 (Paper 1); public-private governance of space infrastructure (Paper 2); the accountability implications of the Swedish Transport Agency's outsourcing of databases crucial to national security (Paper 3); public-private governance of urban rail nexuses in London and Stockholm (Paper 4); and the European Union's policies regarding public-private governance of critical infrastructure (Paper 5).

Other related phenomena that I have studied include the 2005 London terrorist bombings of public transportation (Stern et al, 2014); fire and risk in underground installations and tunnels (Ingasson et al, 2012); the 1997 collapse of an elevated platform in Talsi, Latvia (Newlove, Drukis and Tribis, 2004); crisis management in transitional democracies (Stern et al, 2002); the 1998 Canadian ice storm (Newlove, 1998); Sida's response to the 2004 Southeast Asian tsunami (Bynander, Newlove-Eriksson and Ramberg, 2005); symbology for crisis management (Newlove-Eriksson and Hermansson, 2011); and psychosocial support in crises (Dückers et al, 2018).

The reason why the five papers out of several others were selected to be included in my Doctoral thesis is that those selected all deal explicitly with public-private governance of critical infrastructure. Moreover, the five papers provide diversity but also junctures with respect to issues, types of critical infrastructure, countries, time frames, forms of public-private governance, and how accountability was to varying degrees addressed. The papers are empirically concerned with the European Union, Sweden, the United Kingdom, New Zealand, and the United States. The papers also deal with a variety of critical infrastructures: electricity; ICTs; transport and rail; and space and satellite infrastructure. Moreover, the papers include case studies of specific infrastructures as well as more general policy-focused analyses. In addition, while some of the papers concern shorter crisis episodes, others deal with longer time frames.

Empirical diversity is considered essential for making it possible to suggest and distinguish between analytical generalizations and empirical idiosyncrasies. Other papers that I have written or contributed to, while relevant for other purposes, are more focused on crisis decision-making, preparedness, mitigation and management, and do not explicitly or systematically consider the impact of public-private governance.

Moreover, the five selected papers not only analyze different empirical cases of the overarching research problem, but also link up with one another in more specific ways. Paper 1 and 3 analyze accountability (mis)management in response to crises. While the origins of the crises are of a very different nature (a major prolonged power outage as opposed to un-vetted outsourcing of databases and ICT services), the cases illustrate similarities in how politicization and blame games evolved. Papers 2, 4 and 5 deal not with crisis events, but analyze organizational structures and policies with regard to critical infrastructure and safety/security. While they concern different empirical cases (space infrastructure, rail junctions, and EU CIP policy), they all demonstrate how public-private governance impacts on the varying awareness and management of accountability. It should be noted that there is a minor empirical overlap between Papers 2 and 4 in that the latter partially deals with space infrastructure (which is the sole topic of Paper 2), although Paper 5 more specifically concerns space as part of the EU's CIP policy. The five papers also show some progressive development in my thinking about the overarching research problem. For example, a more nuanced understanding of public-private governance is provided in Paper 4 with respect to the variety and layers of public-private governance, which are not dealt with in the other papers. Finally, unlike the other papers, Paper 5 makes some initial and preliminary observations of the techno-organizational shift, which is further elaborated on in the introduction to my thesis herein. The substance of and linkages across papers are further discussed in the subsequent section Paper Summaries and Contributions, and in the Conclusion.

4.2 Case study methodology

Case study methodology entails in-depth analysis of a single or limited number of empirical cases of a phenomenon. Case studies are particularly useful for unpacking complex

processes and phenomena, allowing for analysis of how a large number of factors interact over time. By contrast, large-N studies seldom account for the complexity, within-case variation and large number of factors that can be grasped by a case study.

Since the task at hand is to explore and explain how accountability in safety management of critical infrastructure is affected by PPG – which indeed implies a high level of complexity (Klinj and Teisman, 2003) – case study methodology is arguably a relevant and useful approach. It can also be noted that case studies are the most commonly applied method in studies of public-private governance (Hodge, Greve & Biygautane, 2018: 1111-1112). Other methods such as surveys and multiple comparative studies are certainly relevant, particularly if among the goals are to observe general patterns and make statistical generalizations. Complexity and contextual dependence of public-private governance explains why the case study method has dominated research on this topic and is preferred.

Case studies obviously cannot generate the type of statistical generalizations that large-N studies can achieve, which means that the conclusions reached cannot be treated as representative of a wider domain of similar empirical cases. Case studies can nonetheless enable *analytical* generalizations, which are useful for testing as well as building on theory. Analytical generalizations are typically formulated as “under what conditions” a particular development is more or less likely, as opposed to statistical generalizations that conclude that X is caused by Y (George and Bennet, 2004; Gerring, 2006; Yin, 2017). Moreover, case studies can both generate propositions to be tested in large-N studies, also laying the foundation for in-depth analysis of “deviant” cases – with patterns out of the ordinary, such as instances of low probability but with high consequentiality. Most importantly however, case studies are a preferable method when the objects under study involve a high degree of complexity, with multiple stakeholders, relations and factors to account for. Case studies are also appropriate for analyzing socio-political processes, when factors and mechanisms come into and out of play over longer periods of time (George and Bennet, 2004; Bennet and Checkel, 2015).

My background at CRISMART not only led me into research on crisis management and critical infrastructure, but also enabled application of a jointly developed structured focused qualitative research methodology (Sundelius et al, 2001), which in turn had practical application for subsequent devise of theoretically and analytically informed crisis exercises.

This qualitative approach is particularly inspired by the late political scientist Alexander George, who also worked together with Sundelius and Stern and the CRISMART team. The approach belongs to the wider category of qualitative case study methodology, but it is also more specific in that it emphasizes both a “structured” and “focused” method:

The method is “structured” in that the researcher writes general questions that reflect the research objective and that these questions are asked of each case under study to guide and standardize data collection, thereby making systematic comparison and cumulation of the findings of the cases possible. It is “focused” in that it deals only with certain aspects of the historical cases examined. The requirements for structure and focus apply equally to individual cases since they may later be joined by additional cases.” (George and Bennet, 2004: 67)

My doctoral thesis is structured and focused in that all the included papers address the question of how and under what conditions public-private governance impacts on accountability with respect to critical infrastructure. Whereas all papers pose the same overarching question and focus on the same type of variables, they also highlight different contextual conditions. In my first contribution in this compilation thesis, I examine the unique case of electricity market privatization in New Zealand where constrained networks ultimately led to cascading failures and a prolonged power outage during a particularly torrid summer.² For example, Paper 2 addresses the growth of private authority in space governance and its general implications for accountability, but also observes conditions specific to this case: transnational conglomerates rather than merely single private companies leading development and management of space activities; and the development of “dual-use” space infrastructure, blurring the boundary between civilian and military use and between public and private, implying a further challenge to accountability.

Given these contextual differences, my collection of papers come close to a “most different systems design”: different settings and conditions, but a similar outcome in that accountability is challenged. Notwithstanding, my thesis observes greater complexity than suggested by a traditional most similar systems design, demonstrating not only that public-

² Subsequent related research confirms my observations on the impact of deregulation and privatization of the New Zealand electricity market on crisis vulnerability. Bertram and Twaddle (2005: 288) observe that lack of oversight led, rather than to the energy provider Mercury Energy (which notably changed its name to Vector Ltd. during the 1998 crisis) addressing infrastructural depreciation and upkeep, unseemly and indefensible profiteering prior, during, and post-crisis.

private forms of governance imply challenges for accountability, but also that they do so in different ways, through a variety of contextual conditions and “intervening variables”. In other words, the significance of contextual variation implies “equifinality”, i.e. that public-private governance affects accountability through multiple pathways. It can thus be persuasively argued that the devil is in the details. These details are too specific and too numerous to be listed here (see the five papers herein), but those that are most analytically significant are elaborated upon in the subsequent sections of this introduction.

4.3 Methods and materials

Case studies allow for a combination of many different types of data and specific methods of source analysis, such as interviews, text analysis, and participant observation. Thus, most of the data and methods used in case studies tend to be of a qualitative nature, aiding the researcher in discovering meanings and complex patterns that are highly contextual and therefore cannot easily be generalized.

Specific materials used in this thesis are:

- Official documents (e.g. policy documents, legal text, audit reports, reports from commissions of inquiry)
- Personal interviews with representatives of stakeholders in critical infrastructure
- News media material
- Academic empirical research

The different types of textual material are used in all five papers, while personal interviews were conducted for the paper on the Auckland power outage. The Auckland case is unique also in that the private electricity operator – Mercury Energy cum Vector Ltd. – while lacking oversight of private *or* public regulators, was in any case subject at the time of the crisis to mandatory information disclosure regarding their financial records. Whereas regulation was lacking in the public to private transition in the Auckland case, something which led to underinvestment and vulnerability of the infrastructure, documents in the public domain could substantiate this conclusion, something that was not indicated in interviews; interviews with key actors at the corporate electricity provider stressed

preparedness and multiple points of systemic resilience, blaming rather factors such as exceptionally high prolonged temperatures and dry conditions for the cascading failures leading to the blackout.

The reason why interviews were not conducted for the other case studies is threefold: there was a lack of time and resources to conduct interviews for the other studies; it was found that document analyses yielded sufficiently interesting results on their own; and, importantly, intellectual property and other economic concerns as well as security and classification issues in critical infrastructure protection inhibit candid expression of interviewees. The latter difficulty with open sources is something which is supported by the literature (cf. Leino, 2017; Klimburg-Witjes and Huettenrauch, 2021) and of which I have firsthand participant observer experience of from working in for example EU Framework Programme research consortia and other security-related projects. Whereas public access to many documents has been legislated in the EU (EC No. 1049/2001) and under Art. 15, TFEU and Article 42 of the Charter of Fundamental Rights of the European Union (CFREU), notable exceptions to transparency include “overriding public policy concerns (public security, defence and military matters, international relations etc.), the protection of personal data, or the commercial interests of a natural or legal person including the protection of the so-called ‘*commercially confidential information*’” (Daminova, 2021: 2). There are thus both commercial and security arguments for confidentiality regarding PPG of critical infrastructure in the EU.

Interviews were considered more crucial for Paper 1 than for the other papers, because of the relative initial lack of documentation in the aftermath of the Auckland blackout. Interviews were conducted as part of a field study to Auckland, with the intention of studying the crisis management of the then recent prolonged power outage. Interviewees were selected strategically, targeting key decision-makers and stakeholders in the Auckland blackout. Representatives of both public and private organizations were interviewed, including public administration, political leadership, electricity production and distribution. The interviews were semi-structured, implying that they focused on a few core analytical themes (including how accountability was understood and allocated) but also that questions were of an open-ended nature and that dialogue and follow-up questions were encouraged (Newlove, Stern and Svedin, 2003).

Official documents of various kinds constitute a main type of source used in this thesis, particularly for Papers 2-5. These types of sources include policy documents, legal text, written speeches, audit reports, and reports from commissions of inquiry produced by national governments, the European Union, and (for Paper 4) city and county authorities. Official documents from corporate and civil society organizations have also been analyzed, insofar as they are relevant for the analysis of stakeholders with respect to public-private governance of critical infrastructure. Official documents are important primary sources, detailing the official views, decisions and statements given by stakeholders. Some official documents, such as audit reports and reports from commissions of inquiry also include critical viewpoints and allocations of blame, which are vital for understanding how accountability is to varying degrees addressed.

News media material and past empirical research are secondary sources which are also of relevance, not only for providing further critical viewpoints, but also for attaining contextual information (such as understanding the flow of events, and how stakeholders react to decisions and indecision). News media material were particularly important for Paper 3 (the case study of the Swedish 2017 Transport Agency crisis), particularly as this scandal was revealed and investigated by the Swedish daily, *Dagens Nyheter*.

5 Appended Paper Summaries and Contributions

Together with the preceding cover essay herein, five papers make up this doctoral thesis. In this section, the contents and contributions of the five papers are summarized. The first paper is originally part of an internationally published monograph. Papers 2-4 have been published in peer-reviewed journals. Paper 5 has been presented at an international conference, and is intended for possible publication in a peer-reviewed journal. The papers are presented in the order in which they have been produced.

5.1 Paper I: Public Sector Reform, Electricity Policy, and Crisis Preparedness in New Zealand

This paper has been published as chapter 2 (pp. 21-50) in *Auckland Unplugged: Coping with Critical Infrastructure Failure* (Lexington Books, 2003), a monograph authored by myself, Eric

Stern and Lina Svedin. I am the sole author of this chapter, even though it is part of a co-authored monograph.

Virtually all of the socio-technical systems that maintain public order, quality of life, and commerce depend on a reliable electrical supply, and critical infrastructure failures such as prolonged power outages have profound implications for citizens and for those who govern in their name. Social scientists have noted the impact of such failures on society and undertake the study of crisis management to improve our knowledge of why critical systems fail and how such systems can be made more reliable. *Auckland Unplugged* is a major contribution to this field.

Using the 1998 blackout of the central business district of Auckland, New Zealand as a case study, a number of important insights are revealed with respect to the central challenges of crisis governance in post-industrial democratic societies. These challenges include: finding an appropriate division of responsibility and labor between public- and private-sector actors; crafting and coordinating a crisis response that addresses perceived threats to community values and avoids the twin perils of underreaction (e.g., passivity or paralysis) and overreaction; coping with competence/authority discrepancies under stress – those who have expert knowledge of the technical issues rarely have the authority to make policy and those who have the authority generally lack the technical expertise to comprehend the subtleties and uncertainties of the issues at stake; and maintaining credibility and legitimacy when facing acute, ill-structured problems in politicized, publicized, and highly uncertain environments. Such challenges are by no means specific to the Auckland outage or to the problem of coping with urban “blackouts.” This study clearly describes and carefully explores general and recurring problems faced by crisis managers around the world.

This contribution explores to some degree extensive governmental reform in New Zealand more generally in the 1990s, in not only electricity distribution, but also with respect to harbors, airports and health services. Corporatization of public services along the lines of New Public Management (NPM) was implemented in every sector. These austerity measures affected crisis preparedness and response in New Zealand as well, which led the Minister of Civil Defence to appeal to the central government to consider the impact of changes on capacity to respond in the event of a major emergency (Newlove et al, 2003:

38). Thus, unlike ports, airports and health services, which under the new regulations were expected to cover unexpected costs of crises through insurance, the central government allowed for an exception for typically uninsurable services included in critical infrastructure in the event of a declared emergency (Newlove et al, 2003: 39).

This allowance proved fortunate for Mercury Energy, which divested itself of a number of assets and changed its' name shortly after the crisis to Vector Ltd. in an attempt to rebrand and recover their heavily tarnished reputation. The ministerial inquiry into the Auckland Power outage revealed not only a lack of infrastructural resilience which led to the crisis, but that the creation of Mercury Energy during deregulation of electricity distribution five years prior to the blackout suffered from multiple failures of accountability and riddled the operation of the patchwork PPG. Main points of organizational and financial contention were found in Mercury Energy's failure to float 25% of their shares publicly as agreed, something which "was intended to provide the basis for corporate accountability by allowing for significant public input in the operations of the company" and in their neglect to publish a statement of corporate intent (Newlove et al, 2003: 44). Beyond the lack of accountability which the New Zealand government inquiry revealed, Mercury Energy was also heavily criticized by an Australian expert review of the crisis for its' lack of engagement in the all-hazards emergency preparedness PPP, the Auckland Engineering Lifelines Project (AELP), often referred to in short as "Lifelines" (Ibid: 46-47). In a seminar on risk management shortly after the crisis, the AELP pointed out the importance of yet further difficulties entailed in coordinating numerous public and private actors.³

This paper shows very clearly the difficulty of finding an appropriate division of labor between public- and private-sector actors. This study also demonstrates that those who had authority did not have the expertise to comprehend the subtleties and uncertainties of the electricity infrastructure, while those with expertise did not have the authority to make policy. Privatization of electricity production and distribution without establishing

³ In the years since the Auckland blackout, the AELP continued its' work and expanded risk awareness in the area of seismic activity and volcanic risk assessment (cf. Daly and Johnston, 2015). In 2000, the AELP changed its' name to Auckland Lifelines Group (ALG), and since 2004 is the "coordinator for lifeline utilities for Auckland Civil Defence Emergency Management (CDEM) Group planning" (ALG, 2021).

accountability mechanisms led to a crisis response that was perceived as incompetent and illegitimate.

5.2 Paper II: Governance beyond the Global: Who Controls the Extraterrestrial?

This paper is co-authored with Johan Eriksson, with myself as lead author. I was responsible for the overarching idea and objective of the paper, wrote parts of the theoretical framework (regarding public-private partnerships), collected the empirical material, wrote the lion's share of the empirical analysis, and was responsible for overall editing. Johan Eriksson connected the paper with the International Relations literature on space and security, and assisted in writing the empirical analysis. The paper has been published in the Taylor & Francis journal *Globalizations* (vol. 10, no. 2, 2013, pp. 277-292).

This article demonstrates the growing salience of private authority in space politics, even with respect to the traditionally state-centric security and military aspects of space. Further, while commercial actors have always played a role in space programs, three significant changes can be detected: transnational conglomerates and consortia as opposed to individual corporations are emerging as key partners in space politics; private partners are gaining stronger and wider responsibilities for the development and management of space programs (including piloted spaceflights); and public accountability is increasingly at stake due to a widening of security in space policy. The latter development includes a blurring of key distinctions between military and civilian usage (also referred to as dual-use or dual-role application), as well as between the public and private realms.

Theoretically, the paper builds on the International Relations literature on the rise of private authority within and across national borders (including the literature on transnational public-private partnerships), as well as the multidisciplinary yet more focused literature on space politics and governance. Empirically, the paper looks specifically at policy, regulatory and organizational developments in Europe and the United States. Multiple and varied types of sources are used, primarily national government and EU-level space policy documents, and scholarly empirical research.

This work demonstrates that the emergence of private authority in space programs is not only about technological development, but increasingly also about command and

control of space activities at large and that public-private space governance is increasingly emerging through transnational conglomerates. This case study also shows how the development of dual-use features in a competitive, lucrative and secretive sector enable further security classification and security-related objectives to gain impetus in European and North American space programs, something which has significant implications for transparency and accountability.

5.3 Paper III: The Invisible Hand? Critical Information Infrastructures, Commercialisation and National Security

This paper is co-authored with Giampiero Giacomello and Johan Eriksson, with myself as lead author. I was responsible for the overarching idea of focusing on the implications of commercialization of critical information infrastructure, collected the empirical material for the case study (on the Swedish Transport Agency ICT crisis), wrote the lion's share of the empirical analysis, and was responsible for overall editing. Giampiero Giacomello wrote the section on the "privatization wave", and Johan Eriksson assisted with the empirical analysis. The paper has been published in the Taylor & Francis journal *The International Spectator* (vol. 53, no. 2, 2018, pp. 124-140).

The paper finds that corporatization of critical information infrastructure (CII) is rooted in the "privatization wave" of the 1980s-90s, when the ground was laid for outsourcing public utilities. Despite well-known risks relating to reliability, resilience, and accountability, commitment to efficiency imperatives have spurred governments in their outsourcing of key public services and infrastructures. A recent illustrative case with enormous implications is the 2017 Swedish ICT scandal, where outsourcing of CII caused major security breaches. With the transfer of the Swedish Transport Agency's ICT system to IBM and subcontractors, classified data and protected identities were made accessible to non-vetted foreign private sector employees – sensitive data could thus now be in anyone's hands. This case clearly demonstrates accountability gaps that can arise in public-private governance of CII.

Theoretically, the paper draws on the wider social science literature on privatization and outsourcing of public infrastructure and services, including that which concerns

ideology and policy, primarily New Public Management (NPM). Empirically, the case study of the Swedish Transport Agency scandal builds largely on newspaper sources – particularly numerous articles in the Swedish daily *Dagens Nyheter*, which first reported on the scandal in the summer of 2017, and continued publishing new revelations during the political and legal processes that followed. Ensuing documents and reports from the parliamentary review of the case are further sources.

This paper demonstrates how Sweden’s trend of outsourcing control over critical information infrastructure (CII) resulted in a major crisis during 2017, causing political leaders to seek to make an about-face and retrieve public control through a stated intent to revert to insourcing. This study also shows how outsourcing of CII was a result of an ideological trend that grew strong in the 1980s and 1990s, leading to privatization, outsourcing and the widespread implementation of New Public Management. Interestingly, the emphasis on privatization and the outsourcing trend has been steady irrespective of rightist or leftist governments in Sweden.

5.4 Paper IV: Accountability and Patchwork Governance in Urban Rail Interchanges: Junctions of London Crossrail and Stockholm City Line Compared

This single-authored paper has been published by the SAGE journal *Public Works, Management & Policy*, 25:2 (2020): 105-131. The paper demonstrates that urban rail centers are increasingly characterized by complex governance where numerous actors are active, from construction to daily operation; complex constellations of public and private actors form patchworked networks in the construction, operation and augmentation of these important urban transport nexuses. The paper examines accountability in safety management affected in and by large public-private urban multi-route stations. Urban rail interchanges are characterized by multiple forms of transport in junctions, continual flows of people, combining adjacent shopping and “mixed-use” areas, parts of which are typically underground. Major interchanges with newly-tunneled lines in London and Stockholm are provided as examples: Stratford station with Crossrail in London; and Stockholm Station City and the City Line in Sweden’s capital. The study finds that patchworks of public-private actors in both cases imply fragmented governance jeopardizing accountability. The time

perspective for both cases span decades, with complex procurement, construction, building augmentation, tight deadlines, turnover of plans, contracts, staff and firms implying uncertainty and lack of institutional memory, posing further challenges for accountability and safety management.

Theoretically, the paper draws on multidisciplinary bodies of literature on public-private partnerships, public safety, crisis management, and public accountability. Empirically, the paper is based on a large and varied collection of primary and secondary source documents covering more than a decade of developments in both the UK and Sweden. The sources include policy, legal and regulatory documents from the local and national levels, reports from commissions of inquiry, statements and policy documents from corporate actors and PPPs, think tank studies, news media material, and scholarly research.

This paper demonstrates in detail how complex patterns of overlapping PPG have developed, and how long-term construction and augmentation of complex transport nexuses impact on turnover and shifting public and private participation. The notion of patchwork PPG is also suggested as a conceptual contribution of more general analytical relevance. This study also demonstrates the unique genesis of the London Stratford station, which was initiated as part of the infrastructural build-up for the 2012 London Olympic Games. This differs from the more typical infrastructural planning in the case of Stockholm Station City. It is also noteworthy that while privatization of security and safety management has gone much further in the London case (following for example a longer tradition of private transport police), concern regarding safety and accountability has been more visible in the Stockholm case. The study shows that this difference might be explained partly by the comparatively higher national and regional significance for the Stockholm station, partly with its “bottleneck” nature, and partly because of the use of this station not only for public transport but also for transport of hazardous materials. This paper also demonstrates how both stations have become multi-use areas, combining underground shopping malls and urban transport, implying a clash between the goals of preventing fires and others hazards (avoid lingering and overcrowding) and commercial interests (maximizing ridership, and encouraging lingering for shopping and amusement).

5.5 Paper V: Critical Infrastructure Integration and Pervasive Securitization in the EU: Implications for Transparency and Accountability

This single-authored and hitherto unpublished paper addresses the rapidly evolving cross-sectoral interconnectedness of critical infrastructures in the European Union (EU), a development studied over the past decade, and asks what the implications are for transparency and accountability. In the name of counter-terrorism and boosting the European economy, the EU now aims at connecting critical infrastructures both in technology, through sensors integrated with “next generation” (5G) telecommunications networks, and in public-private partnerships (PPPs).

The paper finds that, in the name of counter-terrorism and the European economy, cross-sectoral interconnectedness of “critical infrastructures” is propelled in the EU. Critical infrastructures are increasingly technologically connected through sensors in the “Internet of Things” (IoT), in for example transport, via “next” or “fifth” generation (5G) networks, and in public-private governance. Arguably, these under-researched and highly political (if non-politicized) developments can be interpreted as the “securitization of everything”. Whereas ICT and sensor-enabled applications are employed between various domains for numerous, often combined purposes with vast safety, security, and integrity implications, accountability and transparency regarding applications is lacking. Transparency and accountability are not either certain within agencies and/or private contractors regarding infrastructure and applications due to widespread sub-contracting and flux in PPG, differential knowledge, and motivations. Gaps in transparency, awareness, and variable intention in themselves create safety, security, and integrity issues, undermining governance. Securitization legitimates secrecy and confidentiality-driven PPG, motivated by objectives rivalling those of conventional threat projections, implying a neo-corporatist system ultimately putting accountability at stake.

Theoretically, the paper applies securitization theory (stemming from the field of International Relations), and combines this with insights from the crisis-oriented and multidisciplinary literature on transparency and accountability. Concepts drawn from these bodies of literature are then applied in four analytical sections: the first demonstrates how the EU has developed its notion of CIP through a series of securitizing moves implying a loss of transparency, and how the framing of infrastructure as “critical” represents a

securitizing move in itself. The second empirical section deals with how ICT has become the engine of pervasive interconnectivity of infrastructure in the EU, implying challenges for accountability in a fragmented governance context where technology is increasingly embedded and “ubiquitous”. The third empirical section analyses how space systems, in particular satellite systems, have become a focal point for EU military-civilian integration of critical infrastructures – over time from GMES (Global Monitoring for Environmental Security to Global Monitoring for the Environment *and* Security) to *Copernicus* - implying that transparency is progressively and increasingly at stake. The fourth empirical section deals with the development of public-private partnerships for critical infrastructure in the EU, indicating that accountability is at risk. The concluding section suggests that the parallel policy and organizational developments of critical infrastructure in the EU imply a process of pervasive securitization, indicating challenges to transparency and accountability, ultimately endangering legitimacy and trust for the EU system and indeed that of Member States (MS) of the EU which are mutually interdependent integral components.

This paper demonstrates that the European Union advocates interconnectedness of critical infrastructure, particularly through sensor and interconnected ICT systems in the IoT increasingly enabled by higher bandwidth 5G and dual-use satellite communications. It is noted that this development challenges both transparency and accountability. These effects occur due to a combination of developments; yet more infrastructures are considered both “critical” and “dual-use”, thus demanding stronger security and confidentiality measures to be taken, and often that secrecy is applied for both commercial and security reasons. There is also greater potential for inherent faults and cascading effects as critical infrastructures are interconnected, and embedded with sensors and multiple intercommunicative functions carrying greater more compressed data volumes in increasingly miniaturized ubiquitous technologies. These developments mark the point of departure for my observation of a more general techno-organizational shift legitimating ubiquitous intertwined critical infrastructure applications in contemporary society.

5.6 Connection and contribution of the papers

Taken together, the five papers show both diversity and junctures across cases. Table 1 summarizes the main content of the five papers, and how they contribute to my compilation dissertation as a whole.

In summary, the five papers make several contributions. Detailed description and analysis is provided herein about previously under-researched cases of public-private accountability and governance of critical infrastructure. The empirical analyses aid the taking of a step beyond the common observation that governance affects accountability, by elaborating in detailed case studies how, why, and with what effects the complex relationship between governance (of infrastructure) and accountability (in safety management) is played out. Importantly, contracts stipulating partner responsibilities and commitments to for example emergency preparedness remain important for assignment of responsibilities, but the reality of accountability has shown to be more about actual conduct, especially during crises. Participants in PPG constellations often pay lip service to principles of accountability, but when “tested”, words are not always followed by deeds. This is shown particularly by the two papers on crisis episodes (Paper 1 and 3). Notably, while accountability is at stake in all of the cases studied, with similar effects such as attempts to allocate blame among private and public stakeholders, idiosyncrasies in how the “accountability game” transpires are also evidenced.

Taken together, the five papers show *inter alia* that the nature of challenges to accountability largely depend on the perceived national *significance* of the “critical infrastructure” under study. This is illustrated in the study of urban multi-route stations (Paper 4), which found that public accountability concerns were raised more noticeably in the case of the Stockholm “bottleneck” case in comparison with the London Stratford station, where the latter is arguably of less national significance than the former. Likewise, it was found that the “militarization” of space infrastructure, particularly the development of “dual-use satellites” governed by public-private constellations, suggests more noticeable challenges to transparency and accountability than space infrastructure not considered essential for national security (Paper 2 and 5).

Table 1. Appended paper summaries and contributions

	<i>Paper 1</i>	<i>Paper 2</i>	<i>Paper 3</i>	<i>Paper 4</i>	<i>Paper 5</i>
<i>Research question(s)</i>	Why do critical systems fail? How and with what effects was the 1998 Auckland power outage managed?	How, why and with what effects has private authority emerged in the space sector?	How, why, and with what effects has critical information infrastructure (CII) been commercialized?	How is accountability in safety management affected in and by public-private urban multi-route stations?	How and with what consequences has the EU developed policies on cross-sectoral integration of CI?
<i>Geographical area</i>	New Zealand	European Union & the United States	Sweden	Sweden & the United Kingdom	European Union
<i>Type of critical infrastructure in focus</i>	Electricity	ICTs & outer space	ICTs	Railroad, urban stations	ICTs & outer space
<i>Specific case of infrastructure vs. policy focus</i>	Specific case (Auckland power outage)	Policy focus (European and US space policy)	Specific case (Swedish Transport Agency crisis)	Specific cases (London Stratford Station & Stockholm City Station)	Policy focus (the EU's CIP policy)
<i>Time frame</i>	Crisis episode (1998)	Longer time frame (1990s-2020s)	Crisis episode (2017)	Longer time frame (1990s-2020s)	Longer time frame (1990s-2020s)
<i>Scholarly literature used to guide analysis</i>	Social science literature on deregulation, and crisis management	International Relations literature on space, and the rise of private authority in international affairs	Social science literature on CII, commercialization, and NPM	Social science literature on public safety, accountability, and urban rail governance	Securitization theory, and public policy literature on transparency and accountability
<i>Results</i>	Lack of infrastructural resilience, and lack of corporate accountability were revealed. The 1998 crisis was preceded by deregulation and privatization of electricity infrastructure	Space infrastructure including military assets is increasingly controlled by transnational private consortia and PPG	The privatization wave of the 1980s-1990s opened up for commercialization of CII. The Swedish Transport Agency outsourcing of CII implied security breaches, political crisis and lack of accountability	Urban rail centers are governed by complex patchwork PPG constellations, which change over time, with negative effects on accountability. Stations are "mixed-use" areas with built-in risks for public safety.	Cross-sectoral digital integration of critical infrastructures implies a "securitization of everything". This, in combination with sub-contracting and flux in EU PPG, undermine transparency and accountability
<i>Contribution</i>	Shows that accountability may lack despite PPG of CIP; "hands-on" accountability mechanisms through private engagement in and public oversight of emergency preparedness are essential	Shows that accountability is at a loss when infrastructure is dual-use (demanding private and military secrecy), and when governance is transnationalized through private consortia and PPG	Shows that outsourcing of national CII implies accountability challenges and national security risks, which tend to be downplayed by actors advocating commercialization.	Shows that PPG of critical infrastructure may develop in overlapping patchworks, which, in combination with long time frames, imply complex and fragmented governance, jeopardizing accountability	Shows that the cross-sectoral integration of critical infrastructures is driven by political and corporate actors, implying a wider techno-organizational shift in post-industrial society

Similarly, while the 1998 Auckland power outage implied a temporary yet consequential shutdown of infrastructure and services in the capital of New Zealand (Paper 1), the political repercussions were less significant than those of the 2017 Swedish Transport Agency crisis, which revealed a major breach of secrecy regarding data registries of key significance for Swedish national security, resulting in the resignation of ministers and the Director General of the agency in question.

The five papers not only corroborate a general tendency of accountability being negatively affected by complex and fluid PPG constellations, but they also contribute specific pieces towards resolving the puzzle of *how* and *under what conditions* accountability in safety management is affected by public-private governance. The above observation that critical infrastructure perceived as having major significance for national security has more visible political ramifications, including blame games, suggests one such condition. Notably, this interpretation stems not from any single paper, but from observing patterns of difference and juncture across the cases studies.

Moreover, the papers provide elements of three overarching contributions. These contributions concern the techno-organizational shift addressed already at the start of this introduction (originally suggested in Paper 5), the notion of patchwork PPG (brought forward in Paper 4), and observations of governance fragmentation despite digital interconnectedness (noted in Paper 3, 4 and 5). These contributions are elaborated in more detail in the subsequent, final section of this overarching thesis essay which precedes the individual paper contributions which taken together form the compilation as a whole.

6 Conclusion

In this concluding section, I begin by summarizing how the three research questions guiding my thesis have been answered, including how the contributions relate to past theory and research. Finally, based on my research findings and interpretations, I suggest a few recommendations for further research, and public policy.

6.1 Summary of results and contributions

While neither the research questions nor the answers to them have been spelled out in detail above, it may be of heuristic value to sum them up here, in a condensed manner. The first research question asked is *what safety, security and interdependence issues are associated with critical infrastructure, and how are these issues managed?* The research conducted for this thesis reveals a wide range of risks and hazards associated with critical infrastructures. Physical infrastructure such as urban rail centers are particularly associated with the risk of fires, exacerbated if there are underground and multi-use structures sensitive to congestion, implying danger for people as well as for buildings and services (see specifically Paper 4). This is not a novel observation, but rather corroborates what past research has observed (Mueller-Gritschneider et al, 2021; Kühn et al, 2021; Dinmohammadi et al, 2016; Storey, 1996; Sandberg, 2016). By contrast, critical *information* infrastructures (CII), such as national registries of sensitive data (e.g. medical databases, or registries of secret agents), imply national security risks and mainly indirect risks for the integrity and safety of people and of physical infrastructure (see Paper 3). Again, the dangers and hazards observed are not novel but have been observed in past research (for a recent overview, see Dunn Cavelty and Wenger, 2022).

On the other hand, my research also reveals how critical infrastructures are increasingly integrated across sectors, via digital and physical networks (Paper 5). Such cross-interconnectedness of critical infrastructure (e.g. regarding electricity, water, railroad, airports, harbors, health care, financial transactions, and police and military surveillance) implies not only shared information and “interoperability”, but also shared and integrated *vulnerability* to disruptions of digital and physical networks, whether by antagonistic attacks, natural catastrophes, and other hazards. Digital interconnectedness creates “meta-risks” – cascading effects across digital and physical infrastructures.

Against this background, I have suggested that an *interconnected technological and organizational shift* is conceptualized, unpacking how technological and organizational dimensions of the shift are not distinct but intimately connected in a larger process of structural change. This conceptualization builds on but clearly moves beyond past theorizing on structural change, including studies of the change from industrial to information society, globalization, and specific technologies (e.g. cyber, robotics, AI), and

on specific forms of governance (e.g. PPG, outsourcing, and NPM). Specifically, the connected technological and organizational shift is observed in how a mixed public-private structure is increasingly evident not only in governance, but in the infrastructure itself. This is seen for example in dual use-satellites, and in urban rail interchanges that are integrated public transportation hubs, shopping malls and at the same time technological centerpieces.

By highlighting and conceptualizing the techno-organizational shift, my thesis paves the way for research that not only examines specific technologies or domains (such as AI, and space technology), but focuses on how multiple technologies, infrastructures and organizations are digitally and physically interconnected, and what the significant consequences of this shift are. This ongoing techno-organizational shift, especially with regard to the digital and cross-sectoral interconnectedness, has only recently become addressed in scholarly analyses (cf. Schwab, 2017; Newlove-Eriksson and Eriksson, 2021; Dunn-Cavelty and Wenger). The relative novelty of this observation explains why it is still in need of further conceptualization and empirical analysis. My own conceptualization of the techno-organizational mega-shift is primarily spelled out in this introduction, but was originally addressed in Paper 5.

Paradoxically, increasing interconnectivity is simultaneously followed by *fragmentation* of governance and accountability, illustrated mainly in Paper 3 (cf. Dunn-Cavelty and Wenger, 2022). How might integration in one sense lead to disintegration in another sense? This observation is in accordance with a widespread observation on the implications of globalization; whereas functions, malfunctions and problems are increasingly globally interconnected, governance does not necessarily become more unified. There are certainly efforts at striking global accords on for example climate change, energy, Internet policy, and trade – but global governance is generally fraught with problems of participation and compliance (Zürn, 2004). In the words of Rosenau (2000), the world has become “framegrated” – characterized by simultaneous processes of globalization and localization, centralization and decentralization, integration and fragmentation.

Similar contradictory forces appear to be at work with respect to critical infrastructure governance, but in ways that are more specific. When for example a transport nexus such as a major railway station and exchange hub is built and managed, this implies physical and digital integration at the main location, as well as in a wider regional, national and often

international sense, for example with the European Rail Traffic Management System (ERTMS). The implication is that governance structures do not stretch as far as the physical and digital connections of the infrastructure. Not only are the transportation of people and goods connected through jointly owned and operated infrastructure, but frequently other forms of transport (subways, buses and in some cases sea and air transport) and numerous commercial services such as shopping, restaurants and entertainment as well (see Paper 4).

Wireless and cable-bound networks can digitally connect various services, functions, buildings, and organizations together in Collaborative Embedded Systems (CES) – with a major new leap implied by the development and application of higher capacity 5G wireless networks. Further, transport nexuses are connected to local and national transportation control and operations systems, as well as to the national electricity grid. Transportation hubs are also considered to be of critical significance for national and even regional security – as evidenced in the European region with ERTMS – and not just for local or municipal security. Consequently, governance of transport nexuses is typically fragmented, as there is neither any single organization or networked form of governance that oversees the entire spectrum of integrated and interconnected services, functions, infrastructures and stakeholders. Public-private “partnerships” may be organized for the transport nexus, and for more specific parts or functions of it, but none of them cover the whole range of services, functions and connections, many of which extend far beyond the locality and jurisdiction of the transport hub in question.

* * *

The second research question asked is *how is critical infrastructure organized and governed, particularly with respect to public and private-sector actors?* The research presented in this thesis provides multiple examples of public-private governance (PPG) of critical infrastructure, displaying a great variety in size, complexity, and longevity. The case studies show *inter alia* the usefulness of a wide, inclusive definition of PPG constellations, including both formal, contract-based partnerships and more loosely organized networks of public and private actors. A wider and looser definition is perhaps somewhat vague, but casting a wider net is necessary to capture variety and developments in governance over time. This wider

definition is also in accordance with how the concept is defined by leading scholars in the field (Hodge, Greve and Biyugautane, 2018: 1106; Schomaker, 2017; Westervinter, 2019).

Moreover, in looking for answers to the question how critical infrastructure is organized and governed, I coin and develop the concept of *patchwork PPG* (see Paper 4), shedding light on how different forms of PPG can be seen as part of an overlapping patchwork of the “pieced work” of public-private governance. I define patchwork PPG broadly as the existence of two or more PPG constellations which are formally or informally part of a policy program or domain. The concept of patchwork PPG is not limited to a specific policy domain or issue area, although my creation and elaboration of the concept is based on my research on infrastructural projects. My notion of patchwork PPG is helpful in unpacking the complexity of governance, specifically addressing the blurred boundaries of internal-external, public-private and domestic-international. “Patchwork PPG” is an important contribution of mine to the PPG literature, which has primarily been concerned with PPG actors as single entities, rather than a bricolage of organizational bodies, which also change over time. It is also argued that patchwork PPG is particularly prevalent in infrastructural mega-projects and where there is a strong transnational component, such as major transportation hubs and large-scale space programs. Patchwork PPG is something I developed inductively through my own empirical research (particularly in Paper 4), and is not based on past theory or research.⁴

Moreover, by identifying patchwork PPG, questions can be raised on how the different layers and overlapping constellations relate to each other, revealing for example patterns of dominance, collaboration and conflict. For example, it remains to be investigated whether patchwork governance allows actors to exert control and face accountability in other parts of the pieced work, beyond their own immediate partnership. Actors which understand that they are part of a patchwork, and know in what ways organizations and governance are layered and connected – what their mandates, resources and competencies are – are able to develop what I call “nexus power” – to play the role of a doyen in the hive (cf. Bacon in Muntersbjorn, 2003).

⁴ For those interested in the cultural development, technique appreciation and discourse around actual patchwork/pieced work/crazy quilts over time, see for example Peterson (2003).

The third research question asked is *how can accountability in safety management of critical infrastructure manifest in times of crises, as well as in periods unmarked by significant undesirable events?* Of relevance here is that my research shows that critical infrastructure organized as “mega-projects” impacts negatively on accountability, also illustrating how this plays out in particular cases. Mega-projects typically imply a large number of actors, with differing and often varying roles and responsibilities (cf. Flyvbjerg, 2014), suggesting that complicated blame games are likely to ensue in times of crises (cf. Acar, Guo and Yang, 2008: 7; Kuipers and ‘t Hart, 2014; Boin, McConnel and ‘t Hart, 2008). As shown particularly in Paper 4, mega-projects also imply long time frames, which means that organizations join and leave the major endeavors over time, that individual organizations and their staff change over time, and that the overall governance patchwork is also susceptible to change. While the longer time frames of mega-projects have been addressed in past research (Flyvbjerg, 2014), the implications for accountability have not been sufficiently studied. My research demonstrates that even when contracts have been signed, clearly defining roles and responsibilities, these can become defunct as organizational participation changes when contracts do not (see Paper 1), which corroborates findings in past research (Warsen et al, 2018; Murphy, 2008; Wang et al, 2017). This kind of instability implies a challenge for institutional memory, which in turn puts accountability at risk. Moreover, actors that stay longer than others in a mega-project are better prepared to develop “nexus power”.

Further, infrastructural mega-projects have a multifunctional nature, which can imply perpetual conflicts of interest. For example, at urban rail interchanges (see Paper 4), the combination of the commercial interest of encouraging commuters to linger for shopping, eating and drinking and entertainment is at odds with the interest of safety – to avoid congestion and expedite the movement of people to their chosen mode of transportation. Potential risks are further exacerbated by routine transportation of hazardous materials through these interchanges. Similarly problematic, dual-use satellites serve both civilian and military purposes, with development, ownership, command and control dispersed across public and private organizations and with a foothold in several different countries (see Paper 2). With a combination or even clash of several public and private interests built into the very infrastructure, accountability problems might well be exacerbated.

Moreover, my research demonstrates that accountability in safety management of critical infrastructure tends to be negatively affected when governance is fragmented, particularly when there is a patchwork of several PPG constellations, with membership and content pieced together but changing over time. Critical infrastructures imply particular problems for accountability and safety that go beyond “performance accountability” (e.g. accountability for learning outcomes in schools), as the stakes are very high with respect to critical infrastructures, concerning national security. These observations are largely in accordance with findings in past research (Bovis, 2015; Murphy, 2008; Wang et al, 2017: 30).

To be sure, accidents occur irrespective of how infrastructure is governed, but accountability is arguably more easily resolved when governance (and thus roles and responsibilities) is unified. Infrastructure can be owned and operated by purely public agencies, yet still be fragmented, which *ceteris paribus* impacts negatively on accountability. The combination of public and private organizations still matters however. Hence, this thesis contributes to moving beyond the crude observation that governance affects accountability to showing *when* and *how* accountability is affected by governance. In so doing, my thesis goes beyond rudimentary claims that public, private or mixed governance generally affects accountability in a negative (or positive) way.

The case studies presented herein demonstrate that in critical infrastructure public-private partnerships, private actors have been granted greater roles and responsibilities, not only in terms of ownership, services and development, but also in terms of management and command and control. This means that when critical infrastructure failure or accidents occur, accountability battles are likely to be severe and prolonged. My observations thus corroborate that safety and security issues are susceptible to “blame games”, i.e. politicized, bureaucratic, or judicial conflicts over accountability and responsibility for events (Hood, 2014; Schedler, 1999; Kuipers and ‘t Hart, 2014; hood, 2014; Boin et al, 2016). The fragmented governance of infrastructural mega-projects has given rise to the misconception that the rise of private authority in terms of ownership, command and control also implies that private actors have achieved accountability. My case studies demonstrate however, that whereas control of infrastructure can be outsourced, accountability cannot, particularly

when it concerns infrastructure of critical importance for national security (see in particular Papers 1 and 3).

Accountability for critical infrastructure ultimately resides with public authorities, irrespective of privatization, outsourcing or development of PPG. If this is not deemed to be the case, prolonged demands for accountability might ensue, particularly post-crisis when shortcomings are illuminated. This conclusion corroborates past research which stresses that a necessary but not sufficient condition for “successful” accountability management is a clear public lead (cf. Murphy, 2008; Stafford and Stapleton, 2017). This also suggests that “vertical” accountability mechanisms such as court reviews and public commissions of inquiry are essential for critical infrastructure governance. If government officials do not understand, acknowledge and communicate that public accountability remains with government, even where control and oversight has been outsourced or shared with private actors, then not only accountability in specific crises but general legitimacy and trust in government is at risk. That public accountability remains with government is typically also emphasized by private partners working in for example counterterrorism (Lund Petersen, 2008: 417), and financial markets (Svedberg-Helgesson & Mörth, 2012).

Finally, I do not claim that the contributions suggested herein have been “verified” in a conclusive way, but rather that the conditional generalizations they suggest are sustained by my empirical observations which I have documented and published. As my research is primarily based on case studies, limited to certain episodes, issues and political and organizational contexts, I limit my claims with regard to empirical generalizations to the countries and cases studied herein. Further comparative research is needed for testing and elaborating my observations.

6.2 Recommendations for further research, and policy

The techno-organizational shift discussed herein is in great need of further scrutiny. What is offered is an early identification of the amalgamation of infrastructures through public-private governance, as well as preliminary observations of implications for accountability and public safety. Research is needed not only on specific collaborative embedded technologies made possible through advanced engineering in for example AI, robotics,

nano- and biotechnology increasingly enabled by 5G networks and interconnected sensors in various public-private constellations, but particularly on how, why, and with what consequences technological applications are integrated and interconnected – and sometimes disconnected. There is a danger that research continues to be fragmented and increasingly specialized, for example in fields of advanced engineering and innovation, losing sight of overarching trends and patterns as well as broader societal representation and oversight. To be able to analyze a wider techno-organizational shift – how infrastructures and organizations connect and disconnect – multidisciplinary research is warranted, specifically research which incorporates both technological and organizational knowledge, spanning the Science, Technology, Engineering and Mathematics (STEM) and social sciences.

Future developments, like most past technological and organizational shifts, are likely to be uneven, with patterns not everywhere the same. Technological determinism, whether in a utopian or dystopian fashion, should be avoided. Arguably a more fruitful approach is one that begins with open-ended questions about developments, and which considers the impact of temporal and place-specific conditions (cf. Eriksson and Newlove-Eriksson, 2021). For example, are techno-organizational shifts more rapid and more comprehensive in some societies than in others, and if so, why? If developing infrastructure is increasingly controlled by artificial intelligence (AI), can accountability then be assigned to AI, or only to its designers and users (cf. Hedlund, 2020)? Moreover, future research should not be limited to asking how different forms of organization and technology impact on accountability but should incorporate a broader agenda – including how legitimacy, transparency, efficiency, security, and democracy are affected and to varying degrees addressed.

Governance of critical infrastructure is generally becoming more complex and fragmented, a process augmented by the socio-technological shift observed herein. This necessitates capacity and initiative to identify and analyze not only single PPG constellations or simple forms of networks, but also more complex patchwork PPG collaborations – overlapping layers of multiple forms of public-private governance. In response to this need, future research should apply a broader definition of PPG as suggested herein, including both contract-based types of partnerships as well more loosely organized governance

constellations. The existence of patchwork PPG is always an empirical question; it cannot be assumed to exist, and when it is observed, research should account for change, including the possible concentration of governance implying disappearance of patch-worked forms of governance. I suggest however, that research on PPG is typically initiated by examining a single case of PPG and then perhaps comparatively, asks more broadly what public and private (or quasi-private) actors are involved or have some stake in the wider policy domain. It should not simply be assumed that actors identified early on in a research process, for example in a contract-based PPG, are the only actors or constellation of relevance for planning and conducting projects within the policy domain in focus. The net should be cast widely in order to identify and include actors that may initially appear to be of lesser significance but may in fact turn out to play important roles in a wider governance context. Further, vigilance for signs of structural and organizational change should be observed. Identifying patchwork PPG can be compared to the manner in which health authorities conduct infection tracing: when observing representatives of a specific PPG constellation, inquiry should focus on what members in the PPG do and what their roles are, as well as with respect to what other relevant public and private actors beyond that of the PPG in the wider policy program or infrastructural project in question do. Through “snowball sampling”⁵ and studying the wider context of actors and policy, patchworks can be identified, if and when they exist; they are thus not a given.

Finally, the research I conducted for this thesis has made me reflect on some general policy recommendations regarding accountability, which I think are important to share. Accountability for safety of critical infrastructures ultimately rests with public authorities, whether or not ownership and operation have been outsourced to private actors or public-private “partnerships”. This observation has been made in past research (Murphy, 2008; Wang et al, 2017), and is corroborated by my own research (in particular Papers 1 and 3). Moreover, accountability should be considered as perpetually challenged. Accountability is highlighted mainly when accidents occur, and when performance fails to meet expectations. Yet accountability cannot be done away with by merely ticking boxes such as writing in special responsibility clauses in contracts, submitting performance reports or having an

⁵ Snowball sampling is a technique used in research interviews, intended to identify other potentially important interviewees, which the interviewers initially might not be aware of. Put simply, the interviewers, usually at the end of an interview, the interviewer asks: “are there any other persons or organization you think I should contact regarding the topics we have discussed today?” (cf. Noy, 2008).

accountability conflict adjudicated by verdict in court. Rigorous accountability management implies more of a cognitive than regulative preparedness. Critique, mistakes and failures should be expected and endured rather than avoided through symbolic actions or box-ticking.

As a general recommendation for how to respond to accountability challenges, I suggest invoking Albert Hirschman's famous organizational theory of "exit, voice and loyalty" (Hirschman, 1990). "Exit" in terms of resignation is a common response to responsibility for dealing with failures and accountability challenges and is certainly warranted when actors have violated law or regulations, but it does not necessarily do away with the root causes, particularly for such complex phenomena as digitally and physically interconnected critical infrastructure. Likewise, "voice" is a common response to critique and accountability challenges, typically in terms of blame avoidance and allocation of blame to "others"; "it is neither my fault nor my responsibility". Such responses certainly do not promise effective management of actual causes of failures or mistakes. "Loyalty" is the remaining option, but I suggest a different version of loyalty than the one originally intended by Hirschman. Rather than remaining quiet, keeping critical reflections to oneself and simply abiding to the rulings of superiors, I suggest true loyalty is shown when formal responsibility is acknowledged, critique is welcomed and mistakes are admitted, without resigning or resorting to blame games. This form of loyalty is required to be able to truly learn from mistakes, to implement reform, and to allocate resources for effective management. Strategies of exit and voice, by contrast, imply avoidance of responsibility, rather than acknowledging and assuming it. This kind of loyalty corresponds to accountability as "virtue" rather than as "mechanism" (Bovens, 2010; Acar, Chao and Yang, 2008). The approach suggested here is in keeping with the ideal of being loyal to the constitution rather than to any particular individual or "interest", and is ultimately a precondition for good government and functioning democracy.

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