

The role of legislation in critical infrastructure resilience



AUTHORS:

Nader Naderpajouh, Juri Matinheikki,
Madeline Hills

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ABOUT THE RESILIENCE SHIFT

The Resilience Shift exists to inspire and empower a global community to make the world safer through resilient infrastructure. More people than ever depend on the critical infrastructure systems that provide essential energy, water, transport and communications services, and underpin food, healthcare and education. When this infrastructure fails the consequences can be catastrophic.

Supported by Lloyd's Register Foundation and Arup, the Resilience Shift provides knowledge and tools for those responsible for planning, financing, designing, delivering, operating and maintaining critical infrastructure systems. Our aim is to ensure infrastructure systems are able to withstand, adapt to, and recover quickly from anticipated or unexpected shocks and stresses - now and in the future.

DEFINING RESILIENCE

Resilience is the ability to withstand, adapt to changing conditions, and recover positively from shocks and stresses. Resilient infrastructure will therefore be able to continue to provide essential services, due to its ability to withstand, adapt and recover positively from whatever shocks and stresses it may face now and in the future.

ACKNOWLEDGEMENTS

We would like to acknowledge Emergency Management Victoria (EMV) as a crucial supporter of this work. We would also like to recognise the contribution of the interviewees whose anonymity has been preserved, and whose willingness to give their time, and their enthusiasm as subject matter experts, have materially contributed to this study, and to the path of the industry towards further growth in resilience. We would also like to acknowledge reviewers whose valuable comments have improved this research.

Foreword

The Resilience Shift recognises that, to promote a shift in how the resilience of critical infrastructure is delivered in practice, decision-makers need:

1. A common understanding of ‘what’ resilience is and why it matters
2. Tools and approaches that will equip them to put resilience thinking into practice
3. A clear understanding of the drivers and incentives to shift practice towards resilience approaches.

Our work has told us that the drivers of change for critical infrastructure resilience come from three key areas: policy action (including legislation and regulation), financial incentives, and customer demand. There is no single solution for resilience, and most examples of successfully embedding resilience into practice result from a blend of levers.

This report explores the impact of a legislative policy instrument used in the state of Victoria, Australia, and relating to the resilience of critical infrastructure. Based on in-depth interviews with infrastructure owners and operators, it highlights how legislation, as a policy instrument, can drive more comprehensive resilience approaches, both within organisations and at a sector and cross-sector level.

Legislation is an important piece of the overall puzzle, and there are valuable findings from this work, that can inform the strengthening of critical infrastructure resilience in other sectors and geographies.

We are delighted to have supported the authors in producing this report.

The Resilience Shift team

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Executive summary

Damage, disruption or destruction of infrastructure systems, due to natural hazards, malicious attack, negligence or other causes can have a catastrophic impact on the communities that depend on them. These events are increasing not only in frequency but in their intensity (Sewell et al., 2016, IPPR 2019). At the same time, infrastructure around the world suffers from lack of attention and from under-investment.

Public policy, simply defined as actions taken by governments (Keele & Coenen, 2019)¹, aims to provide stability and reduce uncertainty through framing and coordinating behavior (Hadfield and Weingeist, 2012). To support enhanced resilience of critical infrastructure, policy action is vital, but policy also needs to be flexible and dynamic, because of the uncertain and complex future in which our infrastructure needs to function.

As part of our work to better understand the role of policy action in enhancing critical infrastructure resilience, we have explored the effect of the Emergency Management Amendment (Critical Infrastructure Resilience) Act 2014 implemented in Victoria, Australia.

The key insights provided from this case study relate firstly to the implications of legislating aspects of critical infrastructure resilience (i.e. coercive rather than voluntary policy instruments¹), and secondly, to ‘what works well’ in practice, that could or should be adopted in wider practice.

Some key aspects of the Act itself include:

- Participation in a resilience improvement cycle
- Annual submission of a Statement of Assurance that identifies emergency risks and specifies risk mitigation actions
- A requirement to develop, conduct and evaluate annual simulated emergency exercises
- Establishment of Sector Resilience Networks to promote collaboration and knowledge sharing between the Victorian Government and infrastructure owner/operators.

To understand the implications of this legislative framework in practice, we conducted semi-structured interviews with portfolio departments and infrastructure owners and operators from the water and transportation sectors.

We can look at our findings by the level of their application:

ORGANISATION

We learned that legislation brings about a transformation towards better resilience practice, including planning, reporting, and sharing knowledge and best-practice with other organisations. Compliance with the Act has also had an impact on the structure of organisations through either creating new roles or modifying existing roles to cover tasks associated with the Act.

On the other hand, we learned that with limited resources and budget, compliance with the legislation could take priority over other activities, without providing flexibility for organisations to prioritise themselves, based on their individual needs.

Costs and benefits

There is also a cost implication for organisations in terms of addressing new risks, and in terms of compliance through reporting, monitoring, reviewing and enforcement of the Act, as well as cost implications for enforcing and monitoring the practice by the governing bodies.

Benefits observed for organisations (outside of those gained by loss avoidance from disasters) include reductions in insurance premiums, which are balanced against costs associated with employing additional staff, reporting and conducting exercises.

SECTOR

For sectors (in this case transportation and water supply), the creation of formal Sector Resilience Networks, which are enforced through the Act, brings with it the additional dividend of informal networks and social capital that enhances the ability to respond to and recover from emergencies. Knowledge sharing within sectors, and visible and transparent risk management practice, creates a common baseline, and continually 'raises the bar'.



I think [the Act] gives you the ability to look more broadly at what the risks are.

... also perhaps [our approach is now] less prevention focused and more consequence management focused.

Anonymous source

CROSS-SECTOR

We learned that the requirements of the legislation to understand interdependent infrastructure systems creates a sense of assurance, in that organisations can reasonably expect a more reliable service from other interdependent critical infrastructure systems as a result of compliance with the Act. Furthermore, the indirect and direct channels of knowledge sharing, visibility across the sectors, as well as leveraging the Act in the service of interdependent infrastructure systems, creates the effect of industry sectors pushing other sectors to 'raise the bar.

"We do a lot of joint activities [with other sectors]. We're planning one right now ..., and last year we led a four-sector exercise."

Government agency

"They're [infrastructure owners/operators] also very interested in [what other sectors are doing] because they know that they've got these dependencies."

Government agency

"I think the Act as a common set of requirements means there is a degree of assurance that the broader network is resilient... We can take a huge degree of reliance on the fact that all the agencies ... exercise under this Act and have the appropriate diligence, capability, their response plans are appropriate and suitable."

Transportation sector

We also noted the following findings from this research:

A SHIFT FROM RISK TO RESILIENCE

This case study provides evidence of a move from a risk mindset to a resilience mindset in practice, through a change in thinking from security to recovery from all hazards, and from a move towards exploring scenarios with unidentified causes through simulation exercises.

LEGISLATION AS A PIECE OF THE PUZZLE

Legislation is not a panacea and can be complemented with market-oriented mechanisms such as insurance policies, technological innovations, and most importantly community resilience initiatives².

CHALLENGES FOR FUTURE LEGISLATION

In producing this report, we have identified some future challenges that may be helpful to inform the future direction of any legislation in the field of critical infrastructure resilience.



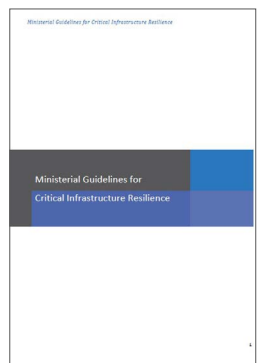
Introduction

A fundamental step in the path towards enhanced resilience in the critical infrastructure is the need for policy action. To better understand this, we studied a legislative policy instrument in Victoria, Australia - the Emergency Management Amendment (Critical Infrastructure Resilience) Act 2014 - hereafter referred to as the Act.

Emergency Management Amendment (Critical Infrastructure Resilience) Act 2014
No. 76 of 2014

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Emergency Management Amendment (Critical Infrastructure Resilience) Act 2014

Victoria's Critical Infrastructure All Sectors Resilience Report 2017

Victoria's Critical Infrastructure All Sectors Resilience Report 2018

Critical Infrastructure Resilience Strategy

Ministerial Guidelines for Critical Infrastructure Resilience

Figure 1
Legislative mechanisms associated with the Emergency Management Act

Legislation of resilience needs to be considered in parallel with other changes, but even by itself, there is evidence that it has instigated a change in practice. This report sets the context for the Act, and explores the following question:

What are the implications of legislation at organisational, sectoral, and societal levels?

This report seeks to provide insights for policy makers on the potential benefits and challenges in legislative approaches to critical infrastructure resilience. It should also inform those involved in the planning, design, delivery, operation and maintenance of critical infrastructure (including developers, owners, and operators) about the change in practice expected from legislative approaches.



Background

Society is increasingly reliant on infrastructure systems to provide essential services, to protect us from harm, and to connect us, to each other and to our places of work. To survive and thrive, communities need their infrastructure systems to continue to function no matter what happens. (Choi et al., 2019).

CRITICAL INFRASTRUCTURE SYSTEMS

Infrastructure systems are defined as the network of man-made systems that function together to provide essential goods and services for the societies (Marsh et al., 1997). Examples of these systems include telecommunications, electricity networks, natural gas and oil, banking and finance, transportation, water supply systems, government services, and emergency services (Ouyang, 2014; Hill et al., 2019). Critical infrastructure systems are those whose failure would have a significant impact on society (Marsh et al., 1997).

Infrastructure systems around the world suffer from lack of attention and under-investment both in the public and private sector.

The American Society of Civil Engineers (ASCE) estimates a 10-year investment gap of US\$2.0 trillion in the USA alone (ASCE, 2017), while globally the OECD estimates the need for US\$96.0 trillion investment for the period of 2016-2030 (OECD, 2017).

In the public domain infrastructure systems are often taken for granted until they stop performing. When a sewage system breaks, a road link is blocked, or an energy transmission system is disrupted, infrastructure systems are in the headlines. Such failures illuminate social, technical, managerial, policy and operational challenges in enabling critical infrastructure resilience.

DEFINING RESILIENCE IN THE CONTEXT OF CRITICAL INFRASTRUCTURE SYSTEMS AND THE COMMUNITIES THEY SERVE

- Resilience encompasses the need for systems to maintain their performance and/or adapt to a new regime of performance in response to changes in conditions (Hollnagel, 2016).
- For communities, resilience is the collective social and technical capital that results in a community returning to normal or transitioning to a new normal following shocks and stresses (Norris et al., 2008).
- Community resilience depends on the coupled performance of infrastructure systems and the community (Centre for Global Disaster Protection, 2018).
- Social and political beliefs, norms and regulations across a network of organisations can have a substantial impact on the management of infrastructure systems (Naderpajouh and Hastak, 2014; Valentin et al., 2018) and, in turn, the resilience of communities (Aldrich, 2012; Naderpajouh et al., 2018).

INTERDEPENDENT SYSTEMS

Infrastructure systems are often defined as systems of systems, i.e., systems that involve actors with operational, managerial, and organisational independence, that evolve through time, are geographically dispersed, and the function of society is one of the emergent outcomes of their operation (as defined by Maier, 1998; and Delaurentis et al., 2011).

To provide services for communities, critical infrastructure systems are connected at multiple points and through a range of mechanisms such as physical, operational, or managerial interdependencies (Rinaldi et al., 2001; Ouyang, 2014; Choi et al., 2019). Interdependencies increase the complexity of the systems and as a result the systems become more fragile and vulnerable (Lee et al., 2007; Zhang and Peeta, 2011).

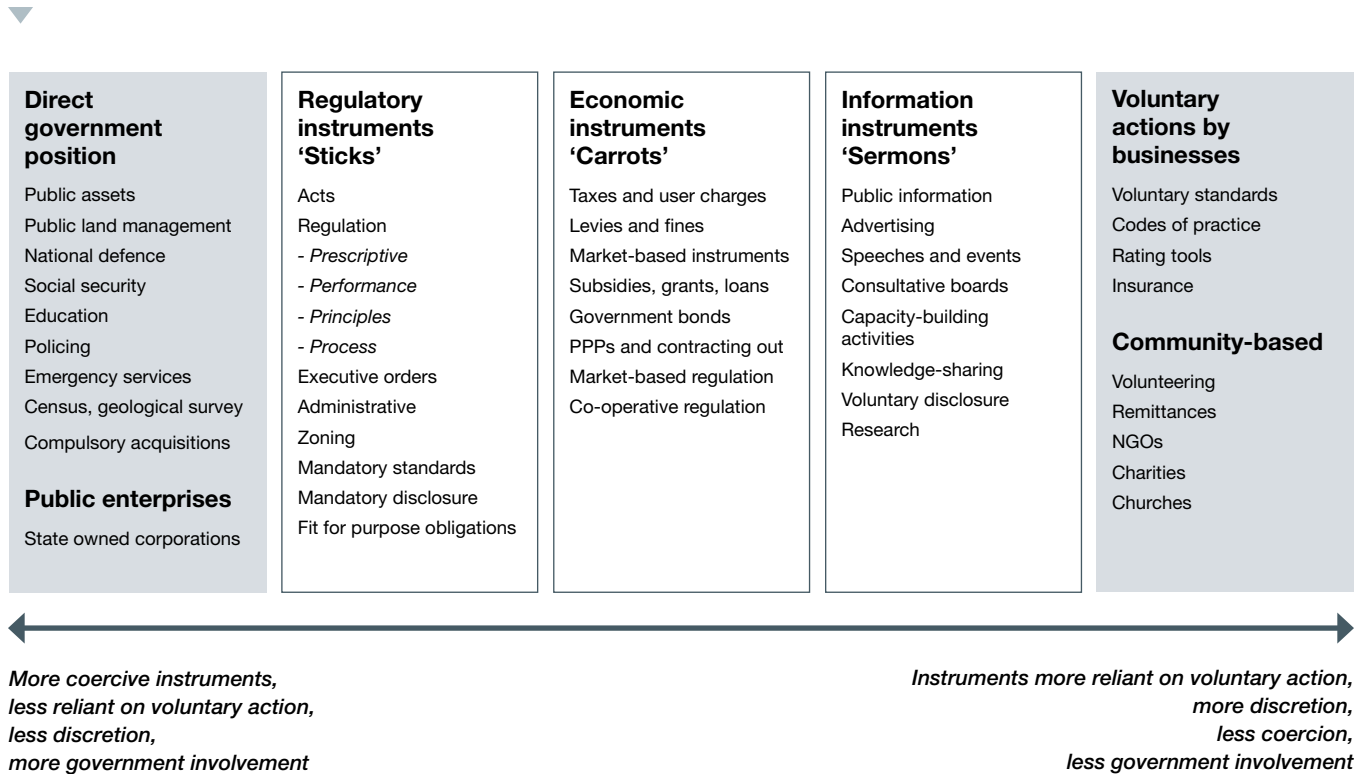
Interdependencies need to be reflected in the management of the infrastructure systems through organisational structures, practices, or cultures.

LEGISLATIVE POLICY INSTRUMENTS

Legislation involves two actors - those that enforce and those that comply. Legislation can also range from from coercive, to voluntary to enabling or a combination of them. Examples of voluntary legislation include environmental policy tools such as the voluntary pollution control agreements in the US and Europe (Segerson and Miceli, 1998), and combination of enabling and enforcing include South Africa's Disaster Risk Reduction legislation (Pelling and Holloway, 2006).

Dr Keele and Dr Coenen from the University of Melbourne, highlighted the 'policy spectrum' in the Resilience Shift research report about the role of policy (Keele and Coenen, 2019).

Figure 2
Spectrum of policy instruments (Keele and Coenen, 2019)



EMERGENCY MANAGEMENT LEGISLATION IN VICTORIA

The Emergency Management Amendment (Critical Infrastructure Resilience) Act 2014 and its related Regulations and Guidelines, which are the focus of this study, should be considered in the context of the overall emergency management legislation in the state of Victoria, set out in Annex 1. When an emergency occurs, all of these mechanisms guide and support the state.

GLOBAL CONTEXT

The case study examined in this report has similarities with policy adopted in other countries, including those in place in the UK (Cabinet Office, 2011) and the US, where the Cybersecurity and Infrastructure Security Agency Act 2018 came into effect within the Department of Homeland Security (DHS) to establish the Cybersecurity and Infrastructure Security Agency (CISA).



Policy for critical infrastructure resilience in Victoria, Australia

In 2014, Victoria introduced new legislative and policy arrangements to improve critical infrastructure resilience and reduce disruption of services to the community due to emergencies.

The reforms augmented existing emergency risk management practices and built on the former terrorism-protection arrangements towards a resilience approach.

It was a collective approach where industry and government consider and plan for the consequences of all emergencies.

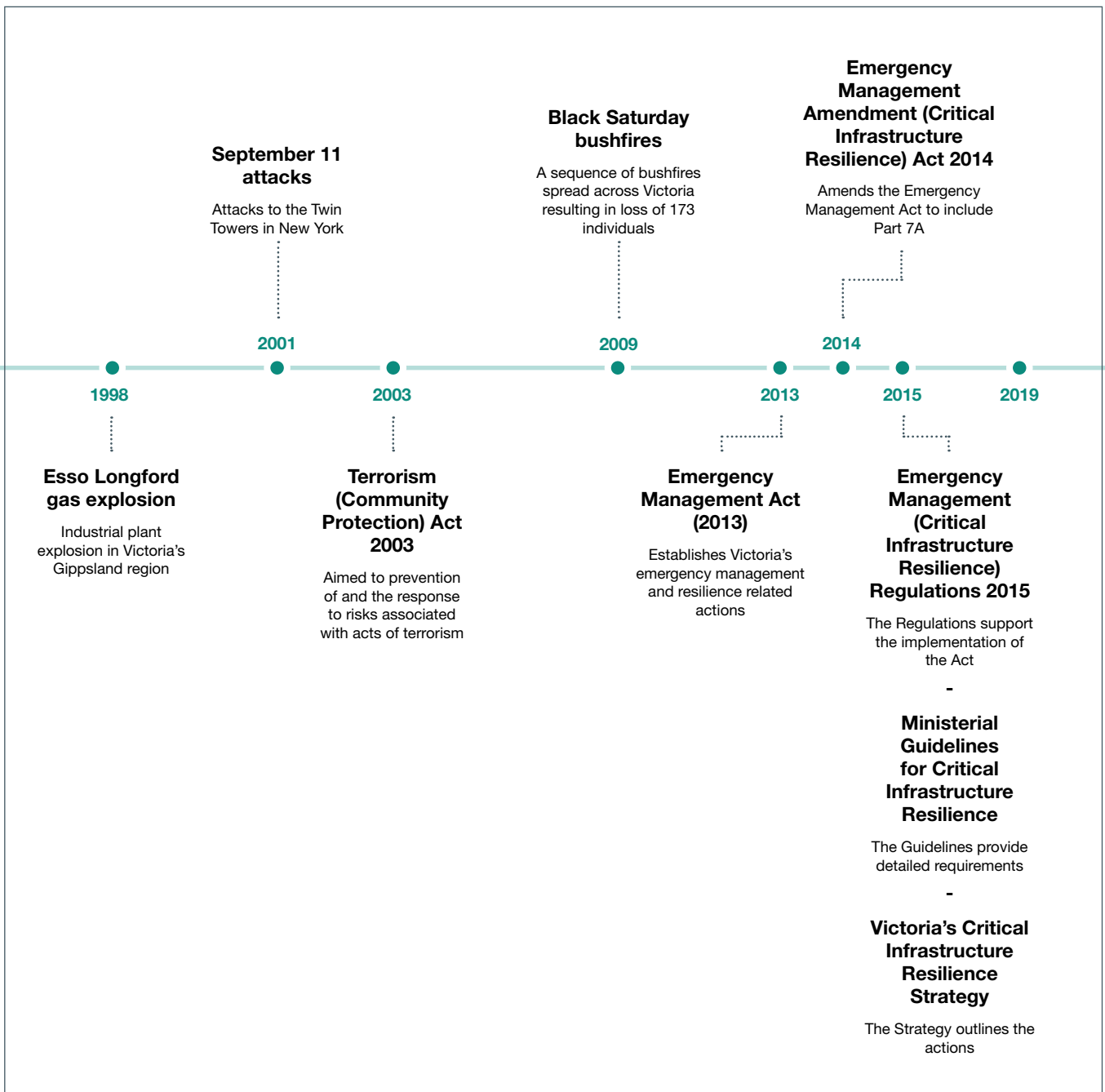


Figure 3
Historical timeline of the legislation

This approach aligns closely with Australia’s National Strategy for Disaster Resilience 2012, which emphasises the principle of shared responsibility between governments, businesses, communities, and individuals. The previous Act was observed not to meet the purpose of community protection, particularly for hazards such as bushfires. According to our interviews, broader understandings of threat were needed, particularly for infrastructure. The 2009 Black Saturday fires exemplified this need. The Victorian Bushfire Royal Commission revealed electricity infrastructure to have caused several fires and their final report³ made eight recommendations specifically related to electricity assets. Following the Victorian Bushfire Royal Commission, several audits, and observations of the need for more clear guidance to industry about actions related to resilience, a five-year process of review

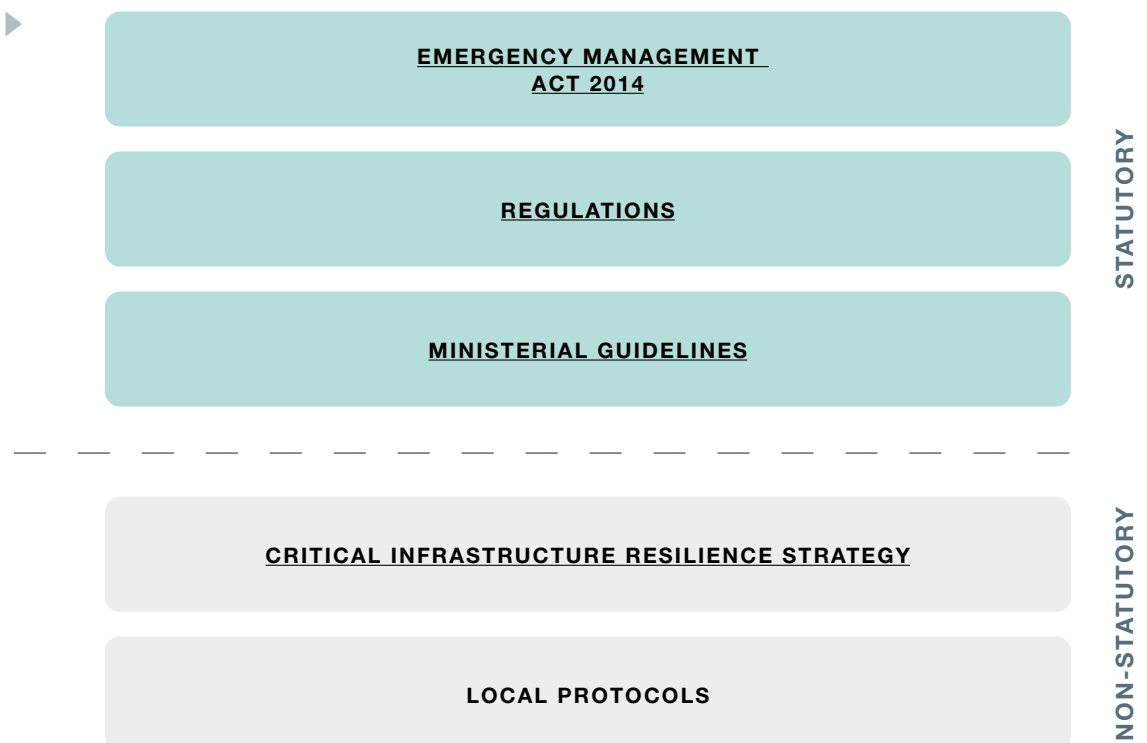
was undertaken, that resulted in the Victorian Government establishing the Emergency Management Act (2014).

Victoria’s Critical Infrastructure Strategy, developed in consultation with government and industry stakeholders, encompasses two approaches for enabling critical infrastructure resilience:

- The Critical Infrastructure Model under which the criticality of infrastructure is assessed and interventions prioritised, implemented and communicated
- The legislation and regulations governing resilience arrangements for vital critical infrastructure.

The statutory and non-statutory arrangements within the legislative framework are shown below.

Figure 4
 The EMV Critical Infrastructure Resilience Act and its components
 (Source: Ministerial Guidelines for Critical Infrastructure Resilience)



Assessing the criticality of infrastructure

The Victorian Criticality Assessment Tool (VICCAT) is used by industry to undertake a self-assessment that is reviewed by portfolio departments⁴. Recommendations are provided by the Governor in Council⁵ who makes the final determination of which infrastructure is vital. Those that are not vital are assessed as major, significant or local.

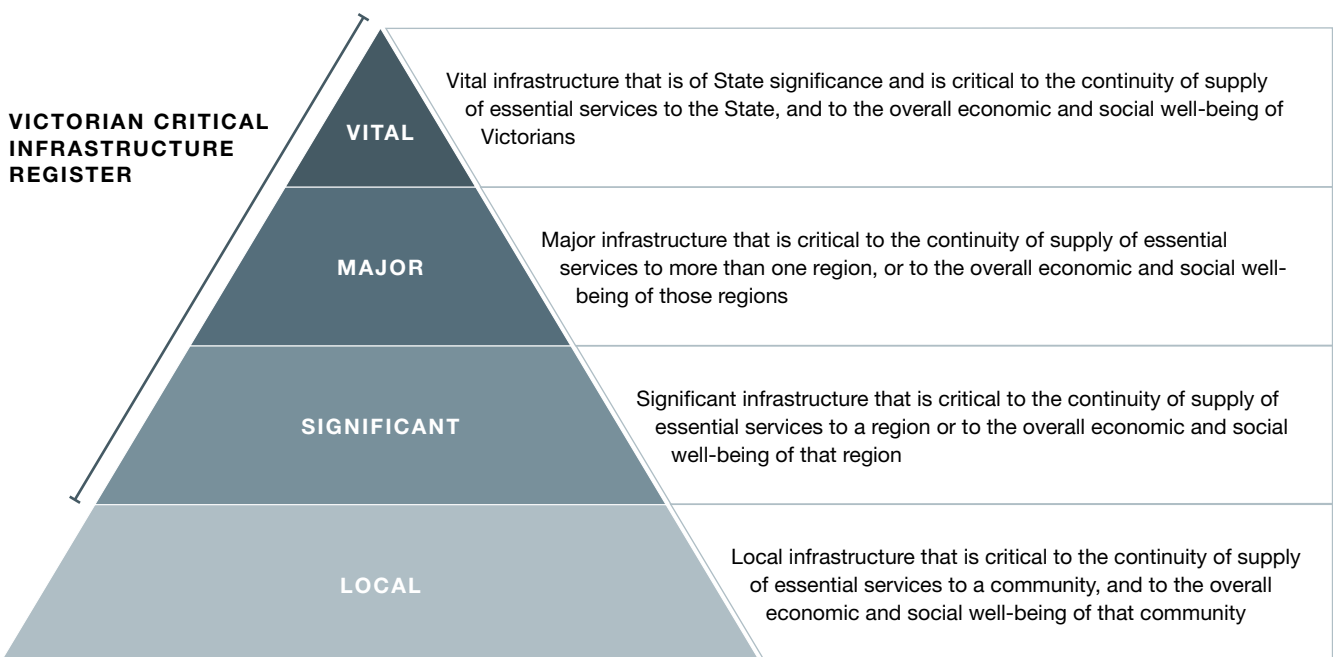
Management of resilience is then mandated based on the level of emergency risk established by the degree of criticality. EMV maintains a register of critical infrastructure across Victoria for assets rated vital, major or significant.

Organisations whose infrastructure is rated vital are required to identify and understand their key risks, report their plans to address these risks, and perform exercises against one of the risks to test their preparedness.

Figure 5

Victorian critical infrastructure model

Adapted from Critical Infrastructure Resilience Strategy, Victoria State Government and Emergency Management Victoria (July 2015)



The resilience improvement cycle

Owners and operators of critical infrastructure designated as vital are required to comply with mandatory obligations under the Part 7A of the Emergency Management Act, including the implementation of a resilience improvement cycle which includes:

- A statement of assurance
- Emergency risk management planning and documentation
- Unless otherwise agreed by the relevant Minister, an annual exercise
- An audit.

The government and operator activities expected as part of the resilience improvement cycle are shown below.

The Regulations prescribe minimum standards for requirements under the legislation (set out in the Emergency Management (Critical Infrastructure Resilience) Regulations 2015 – Statutory Rule No. 82/2015).

Figure 6
 Critical Infrastructure Resilience Act and its components
 Adapted from Critical Infrastructure Resilience Strategy, Victoria State Government and Emergency Management Victoria (July 2015)



STATEMENT OF ASSURANCE

For vital infrastructure, the Act mandates annual submission of a Statement of Assurance (the Statement) by the Industry Accountable Officer with a signed attestation. The Statement must comply with the Regulations and Guidelines, identify relevant emergency risks to the critical infrastructure, and specify the activities addressing the mitigation of those risks that the organisation will undertake.

EMERGENCY RISK MANAGEMENT PLANNING AND DOCUMENTATION

The Regulations require that vital infrastructure operators prepare an emergency risk management plan (RMP) in accordance with relevant international risk management standard ISO31000:2009 Risk management – Principles and guidelines. Further, the Ministerial guidelines outline additional principles to guide entities in their risk management planning including that RMPs must contain the procedures for recovery of the vital critical infrastructure from an emergency risk event, and for its continued safe operation among others.

SIMULATED EMERGENCY EXERCISES

There is a requirement under 74Q of the Act to conduct a simulated emergency exercise.

The responsible entity of vital critical infrastructure, is required to develop, conduct and evaluate an exercise with the intent of testing their planning, preparedness, prevention, response or recovery capability in the event of crisis (Chief Parliamentary Counsel, 2015). An exercise must be developed and executed in accordance with the Regulations and Guidelines, in collaboration with and under the review of the relevant Minister(s), assisting the entity to explore scenarios with unidentified causes. Further, the Regulations stipulate that the exercises must be developed, conducted

and evaluated in accordance with the Australian Emergency Management Handbook – Managing Exercises Handbook 3 (Australian Institute for Disaster Resilience 2012).

As a component of the 12-month Cycle, exercises are an activity undertaken in a controlled environment where participants can evaluate their plans, explore problems, encourage awareness and identify any gaps and contributes to the continuous improvement of the infrastructure (Australian Institute for Disaster Resilience 2012). Here, the level of competency and ultimately the resilience of the infrastructure can be assessed for the cases of emergency.

There are exemptions to participation if the infrastructure owner/operator has encountered an unforeseen stress to their critical infrastructure during the year, as this is deemed to equate to an exercise testing their capability

AUDIT

Responsible entities must conduct an audit of their emergency risk management processes after the completion of an exercise, in line with the international standard handbook HB 158- 2010 Delivering assurance based on ISO 31000: Risk Management - Principles and guidelines. The following principles guide the responsible entities in the planning and conduct of their audits:

- The main focus of the audit should be to evaluate efficiency, effectiveness of the risk management processes
- Audits should form a key part of the responsible entity's assurance program
- Audits should be aligned with the responsible entity's existing processes to avoid duplication
- Audits should be conducted as an independent activity.

Resilience actions for owners and operators

The broader emergency management systems within the Victoria Government outline the governance arrangements for critical infrastructure resilience. They stipulate clear roles and responsibilities, for all relevant parties irrespective of their mandatory or voluntary nature. Sector specific networks provide a vehicle for reporting critical infrastructure resilience plans' development. These networks are collaborations based on shared responsibilities between government and owners and operators of critical infrastructure.

Owners and/or operators of non-vital critical infrastructure are encouraged to develop best practice emergency risk management strategies and practices based on the obligations for vital critical infrastructure, however are not mandated as vital owners and operators.

Based on the suggestions of the relevant portfolio department, the infrastructure owners and operators may be asked to revise and resubmit the statement of assurance, change instructions of the exercise, or even repeat the exercise. In case of non-compliance there are penalties (as stated in the Act: "In the case of a natural person, 600 penalty units; In the case of a body corporate, 3000 penalty units").

The documentation legislation requires that whole process is documented, and creates evidence, that can be referred to in the event of an incident, including the rationale and practice behind each decision.

Sector Resilience Networks

Sector Resilience Networks (SRN) are initiated through the Strategy and promote collaboration and partnerships between the Victorian Government and infrastructure owner/operators⁶.

The networks are forums where representatives of the critical infrastructure sectors come together within their own sector periodically to share knowledge and identify and inform on hazards. These meetings are chaired by the relevant government portfolio department and comprised of members from government and industry. Here, the objective is to understand risks to the sector through information sharing, and to improve the resilience of highly interconnected and interdependent infrastructure.

The SRNs are intended to be platforms for sharing resilience successes and lessons learned for the benefit of the industry overall, as trust is essential for establishing and evolving inter-organisational and inter-sectoral relationships which enables ongoing future collaboration (Dawes et al., 2012).

Each year, there is also an annual all sector meeting to encourage collaborations across the sectors.

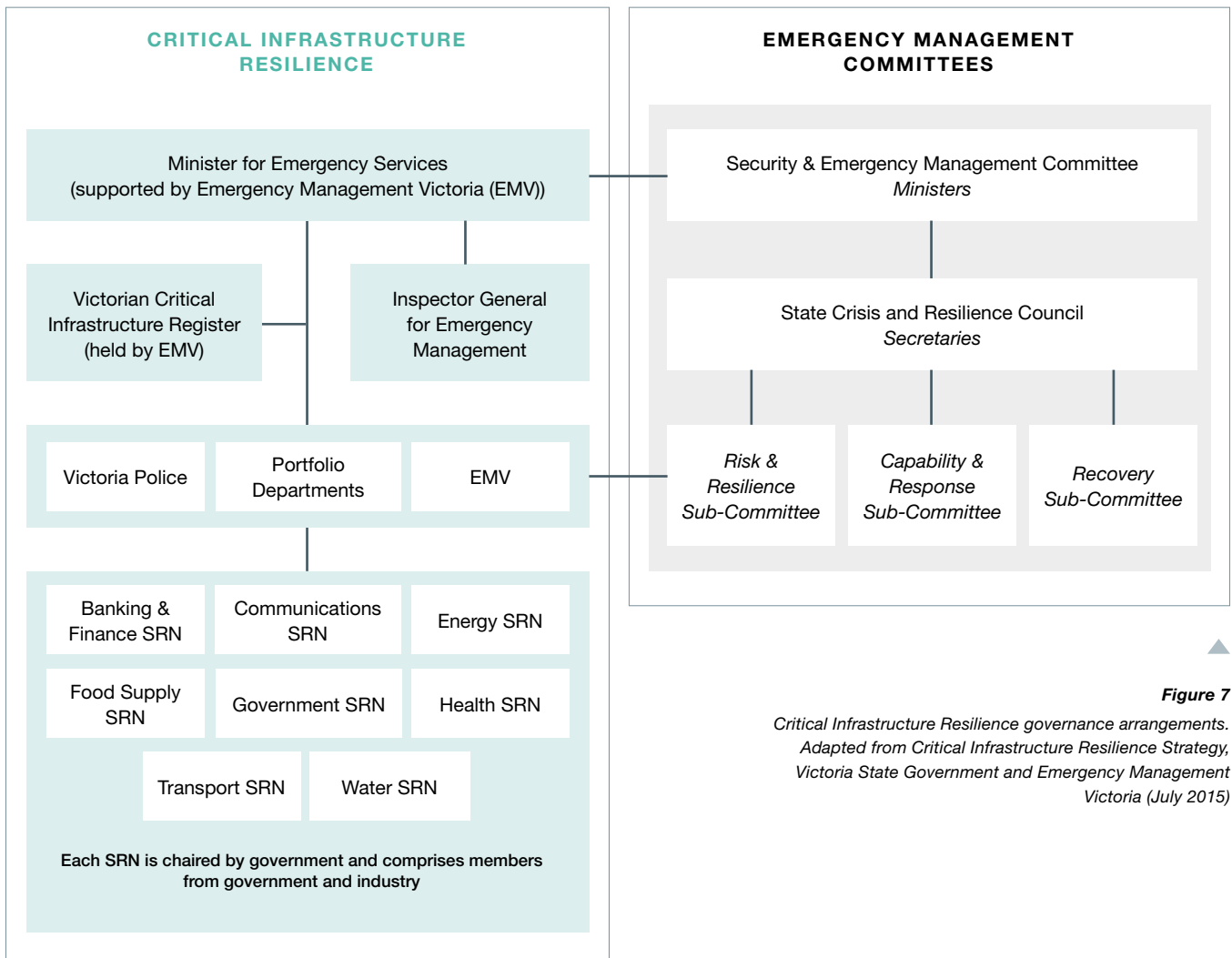
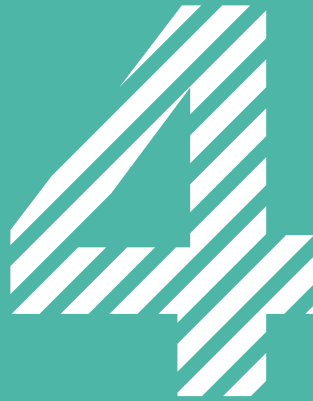


Figure 7
 Critical Infrastructure Resilience governance arrangements.
 Adapted from Critical Infrastructure Resilience Strategy,
 Victoria State Government and Emergency Management
 Victoria (July 2015)

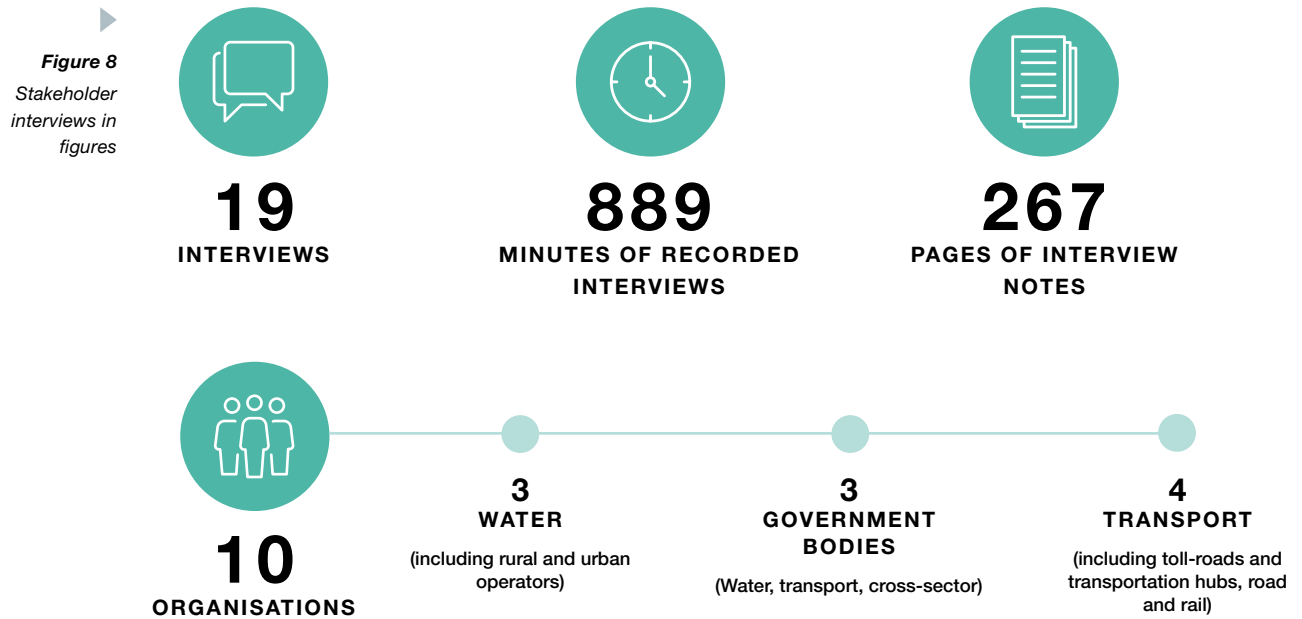


Stakeholder interviews

To understand the implications of this legislative framework, semi-structured interviews were conducted with portfolio departments and infrastructure owners and operators. Due to the research ethics protocols, responses are anonymous, and this report primarily presents aggregate perspectives.

Interviews were conducted across the water sector (including rural and urban operators) and the transport sector (including toll-roads and transportation hubs). Interviewees also represented three government bodies for water, transportation and cross-sector.

In the state of Victoria, the water sector is government owned, and the transport sector predominately privatised. Transport interviewees came from a range of sub-sectors including toll-roads and transportation hubs, and water sector interviewees covered both urban and rural water authorities. The informants were from organisations whose infrastructure was rated as either vital or major, or in some cases both. Companies range from internationally active infrastructure owners/operators, to local firms responsible for a single infrastructure.



19 stakeholders were interviewed, providing a reasonable distribution across the two sectors and the government bodies, and allowing qualitative interpretation of common themes. The findings of this report are based on a qualitative review of the key trends and observations captured.

Interviewees were identified with the support of Emergency Management Victoria, and the final list of interviewees reflects those who were open and willing to participate in our research, given the sensitive nature of the topic, and the geographical limitation of the coverage of the legislation.

TYPICAL INTERVIEW QUESTIONS INCLUDED:

- How is the legislation monitored and enforced?
- What are the implications of the legislation on your practices?
- What are the implications of participation in the sector resilience network?
- What is the current level of organisational capacity to drive changes such as statement of assurances?
- What are the costs associated with either complying with or enforcing the legislation?

ANALYSIS OF THE FINDINGS

The remainder of the report outlines the implications of the Act in various contexts according to the research findings.

This includes the implications of the Act within organisations, within the transport and water sectors, and across sectors.

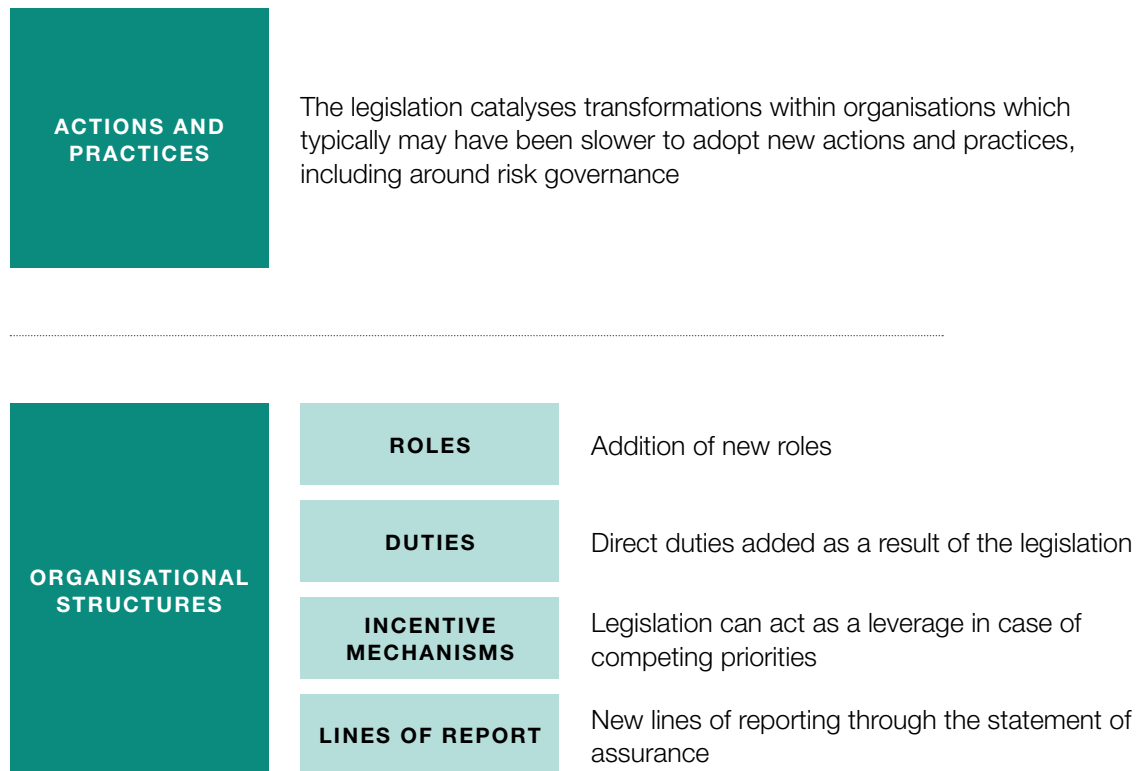
The final sections of the report discusses implications of the findings for critical infrastructure resilience policy, and the challenges for future legislation.



Findings for organisations

The implications of the Act for organisations were considered in terms of its influence on the risk governance baseline; sharing of information within and between organisations and implications for organisational structures and dynamics.

Legislative implications within organisations



▲
Figure 9
Implications within organisations

Actions and practices

Figure 10
Implications for actions and practices associated with risk governance



CREATION OF A RISK GOVERNANCE BASELINE

Interviews indicate that the Act drives sharing of risk governance practice including the consideration of resilience.

“ *Risk governance is defined as the processes through which multiple actors deal with complexities, uncertainties, and ambiguities (Renn, 2017). The risk governance framework developed by International Risk Governance Council (IRGC) includes four stages of risk identification, risk assessment, risk mitigation, and risk communication*

(Bunting et al., 2007).

In practice, risk governance predominately involves risk identification via risk registers. The assessment of risks was often performed by the individual responsible for risk (or resilience or emergency) in consultation with others responsible for risk indicators or the mitigation strategies.

Some organisations follow risk governance guidelines such as the National Emergency Risk Assessment Guideline (NERAG), which is consistent with Australian/New Zealand Standard ISO 31000 Risk management (AS/ NZS ISO 31000-2009) and some others follow their Safety and Environment Management Systems. It is important to note that risk governance was already in place prior to the legislation, the key impacts of the legislation were further establishing a baseline for risk governance through sharing knowledge on practices as well as on emerging risks.

BENCHMARKING INFRASTRUCTURE

Some organisations (from the transport sector) also follow Global Real Estate Sustainability Benchmarking (GRESB)⁷.

GRESB assesses the Environmental, Social and Governance (ESG) performance of real estate and infrastructure assets worldwide. It provides data, scorecards and benchmarks and the investors and industry determine the materiality of issued assessments. GRESB has recently added resilience to its assessment scope. It can be observed that inclusion of practices associated with resilience is a trajectory in the standards⁸.

Figure 11
Implications for risk governance practices

Legislative implications for risk governance practices

CREATION OF A RISK GOVERNANCE BASELINE

Organisations follow an additional procedure of reporting major risks and mitigation measures in their Statement of Assurance, consequently sharing their risk assessment practices with the sector

ADDITION OF NEW RISK INDICATORS

Organisations learn about other risks and start to add them to their risk registries. This facilitates further risk understanding and encourages organisations to proactively consider a wider range of potential risks

BETTER UNDERSTANDING OF MITIGATION

The legislation has created incentives and opportunities for organisations to learn from each other’s successes, failures, expanding their portfolio of risk mitigation options. These exchanges primarily occur through annual exercises and sector resilience networks

SHARING OF RISK INFORMATION

The Act requires organisations to report risks to their assets, and their associated mitigation plans, to portfolio departments. This facilitates information sharing and development of best practice understanding between industry and government. One interviewee cited identification of risks related to management of corporate communications as a direct result of sharing knowledge between organisations.

Despite the presence of industry wide standards, the level of detail in risk governance varied across organisations interviewed, often relative to their size, sector, maturity in addressing risk and resilience. The key difference between water and transport related to the standards they follow, rather than to the maturity of their risk management.

We learned that the Act has created incentives and opportunities for organisations to learn from each other and expand their risk governance practice. For example, if a risk is raised and discussed in detail in the SRN meetings, other organisations then start to explore the implication of this risk in their own business. The legislation works as a catalyst within organisations to increase awareness and communication of risk governance and resilience at all levels.

Through the Act, different parts of the risk governance practices are reviewed by the governing body as they report them in their statement of assurance, which results in further ratification of the process.



I understand it to be more than just operational,... And really it's about good business governance.

Rod Young, Emergency Management Manager, Transurban

Implications for organisational structure

Key findings related to organisational structure are detailed as follows:

NEW ROLES, SUCH AS EMERGENCY OFFICERS, OR MODIFICATION OF EXISTING ROLES

The data revealed that government owned organisations often added a new position while private sector organisations modified the roles and responsibilities of the existing positions to cover tasks associated with the Act (such as reporting for Statement of Assurance, participation in required meetings such as the SRN, and preparation for the exercises).

AN ORGANISATIONAL LEVER FOR BUY-IN AND ACTION

Legislation can be used as a lever to secure resources for risk and emergency management, and to secure the support of senior management, a board or shareholders; this was supported in the research findings.

“Well, when you’ve got a lot of competing priorities, sometimes you do things because you have to.”

Infrastructure owner/operator – water sector

The legislation also supported risk and resilience activities and decisions to be actioned over other competing priorities. However, this was found to create challenges in the face of limited resources and competing priorities. For example, one infrastructure owner/operator who we interviewed had to invest in their operating equipment to comply with the legislation. This resulted in compromising costs that could have been invested in proactive monitoring, or preventative maintenance plans.

INCREASED RESOURCE ALLOCATION

Another example is the significant resources that organisations allocate to perform an exercise every year. Without the legislation organisations could reduce the frequency of exercises and divert the resources elsewhere. As one infrastructure owner/operator from the water sector noted “there were a lot of other things we wanted to do as well”.

The observed cost of compliance with the legislation can be related to: increased reporting, monitoring, reviewing, and or enforcement.

In the long-term, compliance requirements (and practices associated with them) are likely to become more efficient via sharing knowledge and practice between organisations, internal evaluation and continuous improvement processes (Grant and Baden-Fuller, 1995; Zhang and Dawes, 2006). Internal evaluations and inter-organisational collaboration will improve the efficiency of implementation as it facilitates transfer of knowledge across the organisational silos (Pemsel and Müller, 2012), which may increase the impact of the practices associated with the Act.

However, there is a need for established procedure of assessing the impact of the legislation in terms of costs and benefits, as well as benchmarks to assess improvements.

COSTS AND BENEFITS

There are costs associated with compliance with, monitoring and enforcement of the legislation. Benefits observed for organisations (outside of those gained by loss avoidance from disasters) include reductions in insurance premiums, which are balanced against costs associated with employing additional staff, reporting and conducting exercises.

Further work is required to understand the true nature of these costs in contrast with the wider benefits, both organisationally and for society. Furthermore, the implications of the legislation on the opportunity cost of resource allocation which could be spent elsewhere, needs to be better understood.

MODIFICATION OF LINES OF REPORTING OR CREATION OF NEW LINES OF REPORTING

The legislation has created additional lines of reporting associated with the Statement of Assurance. The Statement of Assurance must go through internal review before being shared with the portfolio departments.

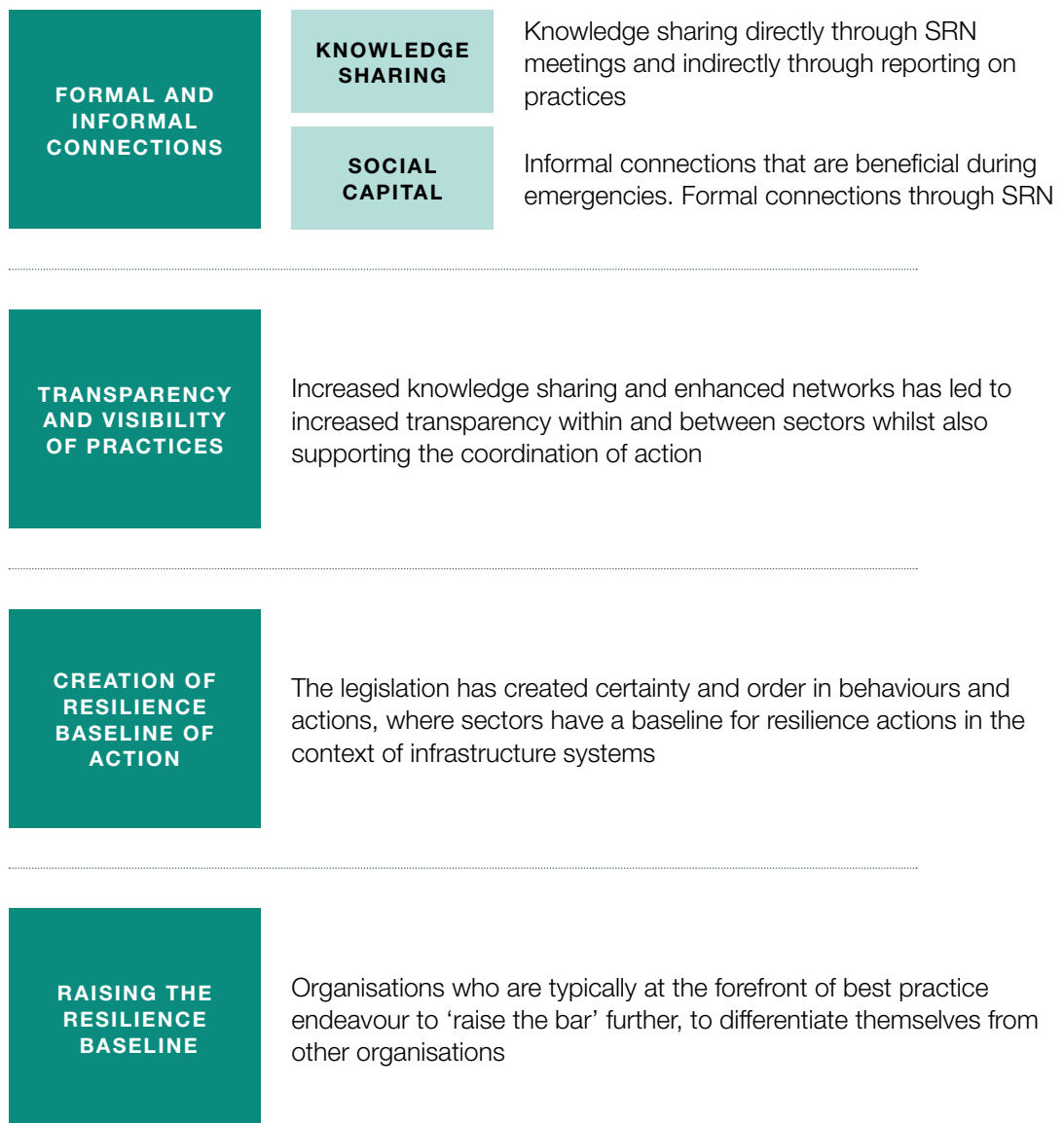
These changes in practice and organisational structure may also result in requirement of additional resources, particularly in the earlier stages of the implementation of the legislation where individuals need to learn how to address and understand new risks or how to create required reports.



Findings for sectors

The research identified general trends within the transport and water sectors. This included the activities related to formal and informal networks, the visibility and transparency across organisations, and ‘raising the bar’ of the resilience baseline within and across sectors. These findings are discussed in further detail below:

Legislative implications for within sectors



▲
Figure 12
Implications within sectors

Formal and informal networks and knowledge sharing

The legislation supports the establishment of resilience-based networks and relationships, whether formal or informal or within or between organisations.

An important outcome of the legislation is that the similarity of the risk governance practices is increasing across organisations.

Organisations whose infrastructure is rated vital are required to identify and understand their key risks, report their plans to address these risks, and perform exercises against one of the risks to test their preparedness. As a result, the Act works as a central instrument in creating what DiMaggio and Powell (1983) called “institutional isomorphism.” That is, in order to appear legitimate to different actors in their field (including regulators, communities, or even competitors), the organisations tend to become similar in their practices.

Organisations need this legitimacy to create a sense of identity and establish themselves in their sector. Similarity of practice is achieved by enforcement (for vital infrastructure) or responding to newly established norms of practice (for non-vital infrastructure).

Our interviews confirmed that organisations aim to adopt a more rigorous risk governance approach and learn from the early adopters in the market. Interestingly, there is a high level of peer recognition and reciprocity in the sectors through the SRN meetings. It also emerged that the context of resilience created an altruistic environment, and it was observed that

individuals volunteer to share their knowledge and experience of their organisations within the SRN meetings.

An interesting outcome of the Act was to create not only formal connections, but also informal connections among the individuals, through the SRN meetings for example, that drive resilience across these organisations. Informal connections are critical for resilience of the infrastructure systems and can be considered as a form of social capital.

All three types of social capital that were suggested by Aldrich and Meyer (2015) have been observed as a result, since individuals created (i) bonding social capital within their own networks, (ii) bridging social capital between the networks (for example between the owner/operators and the response organisations such as police), as well as (iii) linking social capitals with the authorities.

For example, emergency managers can have confidence that they can personally contact individuals outside their organisations in case of response and emergency, while they can also rely on each other for knowledge sharing and learning.

Personally knowing an individual “to call at 4AM during an emergency” is significantly improving the efficiency and speed of the process and therefore resilience. This is specifically important across the interdependent infrastructure, as one informant suggested that traditionally, the contact procedure for interdependent infrastructure is not established. In our research we observed an evolution from, initially, a certain level of enforcement to connect a number of actors and then, over time, a sector wide momentum for engaged communication and collaboration through networks.



[For] example I contacted the SRN members last week to understand what other corporations were specifying in terms of the competency for their board and executive members from a[n] emergency management perspective, just to benchmark what other corporations had specified because there's been no guidance from the regulator in that area.

Infrastructure owner/operator, water sector

Creating visibility and transparency of practice

Increased knowledge sharing and networks has led to increased transparency within and between sectors and to the coordination of action.

The Act resulted in the creation of a sense of assurance (organisations can have confidence in what other organisations will do), which in turn creates a general sense of reliability, both within and between infrastructure sectors, and indirectly contributes to a system approach to resilience as suggested by OECD (2019).

However, most of the reported and observed connections were between organisations within one of the sectors, as well as with the response agencies, and the government. All sector resilience network meetings which happen on an annual basis may be considered as a venue to further facilitate such connections if needed.

Creating a resilience baseline

Our interviewees told us that government departments also learn from the early adopters and market leaders, through the annual Statement of Assurance reports and the SRN meetings and will indirectly transfer this knowledge to others in the same sector. This is in addition to the direct sharing of knowledge between organisations discussed in the previous section. This can happen either through revision of regulations and legislation (enforcement), or recommendations and feedbacks to the infrastructure owners/operators and incentive mechanisms (enabling). This centralised flow of knowledge sharing creates a baseline and raises the minimum industry standard in the risk governance process.



I think having... the transport SRN appears to have uplifted the wider industry.

Infrastructure owner/operator,
transportation sector

In this process, no visible difference was observed between the water and transport sectors, even though one is mainly government owned and the other privatised. The lack of visible differences can be attributed to the fact that even the transport sector, which is highly privatised, does not experience direct competition, as the involved actors are serving different jurisdictions (for example a different toll road, or station) and do not directly compete with each other.

Raising the bar

We also learnt that a common baseline has another consequence – organisations who are typically at the forefront of best practice (referred to below as ‘early adopters’) endeavor to ‘raise the bar’ further, to differentiate themselves from other organisations. For example:

- Early adopters plan for more extensive emergency exercises and invite broader ranges of their peers and government bodies to these events.
- Through SRN meetings, which may focus on a specific relevant threat, e.g. cyber resilience, early adopters have an opportunity to address these risks.

In this way, knowledge and best practice will disseminate within the industry and a new baseline will be created on each specific raising threat by the early adopters, and then it will be gradually adopted by a wider range of organisations through the mechanism explained above as ‘institutional isomorphism’. The work presented in this report showed this cycle to be the case in the water and transportation sectors.

This key finding demonstrates the value in removing some of the silos that exist between organisations and between sectors when it comes to resilience whether they be institutional, policy, cultural, procedural or financial.



Cross-sector findings

Some of the findings from this research are applicable across sectors and should be relevant more widely than transportation and water, the two sectors studied here.

Broader implications across sectors

REFLECTING INTER- DEPENDENCIES

Infrastructure owners/operators used the legislation to support requests for a better service from organisations that own or operate interdependent infrastructure systems

SENSE OF ASSURANCE

Interdependencies were addressed indirectly through the legislation, by creating certainty in the behaviour of other organisations within and between sectors

CREATION OF RESILIENCE CULTURE

A culture of resilience was also observed within organisations that were not obliged by the legislation, developed as a result of their proactive participation in networks and resilience actions



Figure 13

Broader societal implications

Creation of sense of assurance

Our research found that interdependencies were addressed indirectly through the legislation, by creating certainty in the behaviour of other organisations within and between sectors. Organisations now expect a more reliable service from other interdependent infrastructure systems as a result of compliance with the Act, and of the creation of the baseline on risk and resilience activities. However, there is a fine line between a sense of assurance and over-confidence, that needs to be considered by the organisations.

Incentivising management of interdependencies

We learnt that infrastructure owners/operators used the legislation to support requests for a better service from organisations that own or operate interdependent infrastructure systems. For example, one interviewee told us that a water operator requested an upgraded telecommunication service from a telecommunication operator based on the need to comply with the Act.

A barrier to managing interdependencies in practice with other infrastructure systems is the lack of clear incentives to do so – the business case in terms of ‘who pays, who benefits’ is not clear⁹. In this case, the legislation, whilst not articulating the business case, fills the void in other ways, for example:

- Using the legislation as an incentive as per the example above
- The legislation for owners and operators directly requires them to understand and report on interdependent infrastructure systems
- Creation of a sense of assurance as mentioned above.

Creation of a resilience culture

Broader societal implications of the legislation can be further discussed in terms of the awareness as well as societal impacts. While we did not specifically study the general awareness of the public, our interviewees suggested that the general public awareness of the legislation is low. For example, several organisations mentioned that the public do not know about the Act and/or the level of resilience of the asset that they are using. Arguably, increased public awareness might help to create political capital in support of the efforts and potentially increase the impact of the Act.

To support resilience actions, there is a need for combination of resources (Naderpajouh and Hastak, 2014), including: legal (created by the Act itself), public, financial, knowledge, technical, normative, cultural-cognitive, or network bases of power.

For example, the public can support actions related to the Act and resilience of the infrastructure at the community level through electoral power. In this sense, the legal power will be an enabler of the community actions and can act as suggested by the community resilience framework of EMV (2017).

SUPPORTING INNOVATION

Legislation by nature inhibits innovation as its main characteristics are to establish the culture, mindset, and norms of practice. Along with the need to establish frameworks of practice, sustained improvement necessitates the need for opportunities to innovate and emergence of novel practices. The UK Regulators Network (UKRN) (2015) has suggested the need for regulators to understand the nature of cross-sectoral innovations, their enablers and inhibitors. Examples suggested by UKRN (2015), provides examples of cross sectoral innovation in terms of business models (e.g. smart metering of the coupled networks), processes (coordination among infrastructure sectors), as well as technical aspects (e.g. combination of infrastructure systems for a joint purpose).



**A shift from risk
to resilience**

The transitions associated with the creation of the culture of resilience can be framed in terms of “the shift from risk to resilience,” proposed by Aven (2018), and Park et al. (2013).

RISK



LIKELIHOOD OF EVENT HAPPENING	STATUS OF EVENT	RISK CLASS				
		M	H	H	VH	VH
5	It is or has already happened	M	H	H	VH	VH
4	It will probably happen	M	M	H	VH	VH
3	It could possibly happen	L	M	M	H	H
2	It is to happen	L	L	M	M	H
1	It is unlikely to happen	L	L	L	M	M
LIKELY OUTCOME OF EVENT	SAFETY	Near Miss	Minor Inquiry	Lost Time Accident	Major Inquiry	Fatality
	ENVIRONMENT	Potential Event	Minor Event	Important Event	Significant Event	Major Event
	COST	< 1k \$	< 10k \$	< 100k \$	< 300k \$	> 500k \$
	SEVERITY	1	2	3	4	5

Name	Description	Foist Upper	Foist Lower	Units	Weight	Tabletmob	Pbctio
PAS275	Percentage of patients achieving 75% reduction in baseline PAS27 at week 32	60.0	0.0	%	1.0	29.5	2.7
PGA	Percentage of patients achieving Physician's Global Assessment (least) at week 32	40.0	0.0	%	0.8	295	5.1
DLA	Percentage of patients with Overall lesion severity rating of minimal or clear at T1 (day 84)	40.0	0.0	%	0.25	32.1	2.9
DCI	Demographics Life Quality Index: Mean percentage of patients showing an improvement	30.0	0.0	Change score	0.8	5.8	2.1
AEI	Percentage of patients exhibiting injection site reactions, mild to moderate close related across the five symptoms	50.0	20.0	%/100days	0.2	43.0	24.0
Severe infections	Proportion of patients experiencing infections serious enough to require hospitalization	3.00	0.00	%/100days	1.0	2.83	1.4
Severe Neurodevelopment	Number of cases exhibiting severe (grade 3 and above) neurodevelopment	30	0	number	0.8	9	0
Proximal Severe Events	Percentage of patients developing severe forms of proximal neurodevelopment (proximal)	4.0	0.0	%	0.05	3.2	1.4
Hypersensitivity Reactions	Percentage of patients exhibiting hypersensitivity reactions, anaphylaxis, pericarditis, arrhythmia, tachycardia, QT and PR interval increase	10.0	0.0	%	0.05	5.0	0
Immune-mediated Long Disease	Number of cases of immune-mediated long disease	30	0	number	0.1	18	0
Inflammatory Myocarditis	Number of cases of inflammatory myocarditis	5	0	data	0.02	4	0
Ischaemia	Number of cases of ischaemic stroke	25	0	number	0.12	24	0
PMI	Number of cases of progressive multifocal leukoencephalopathy	5	0	number	1.0	3	0
Aspic Meningitis	Number of cases of aspic meningitis	30	0	number	0.1	29	0

RESILIENCE

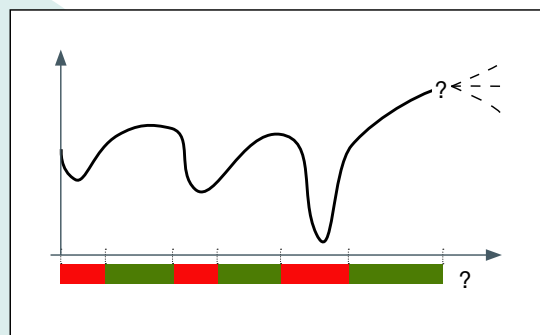
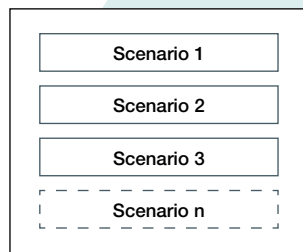
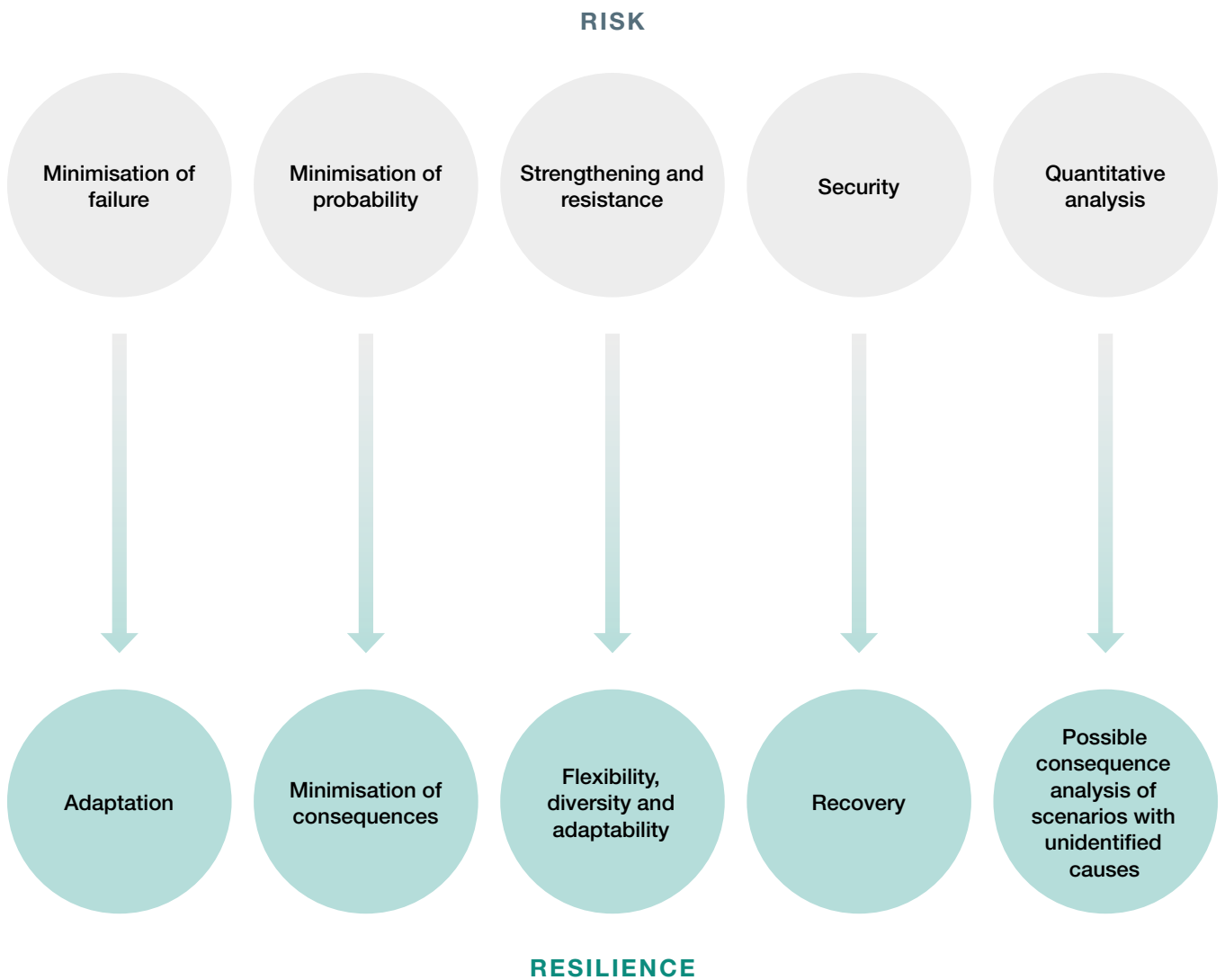


Figure 14
Shift from risk to resilience

Figure 15

Five theoretical transitions indicating a shift from risk to resilience (Park et al., 2013; Aven, 2018)



Of these five theoretical transitions, at least two were observed in practice through our research.

- Moving from security to recovery, and from single threats to an all hazard approach. An all hazard approach (e.g. OECD, 2019) was created naturally in this case through a bottom up process of considering the needs and recommendations of the organisations.
- Organisations whose infrastructure systems are rated vital are required to perform an exercise on one identified risk, to help them explore consequences of scenarios with unidentified causes.

The move towards flexibility and adaptability, and minimisation of failure were also noted as being key facets of the legislation:



Essentially ... we're trying to prevent services being significantly disrupted ... We understand that these services are critical for our community, for social wellbeing ... economic wellbeing ... The idea is to have systems that are flexible and adaptable to a changing environment ... and have some redundancy or systems in place that are flexible [to] prevent or minimise that initial disruption to the community."

Quote from an individual on the enforcement side of the legislation

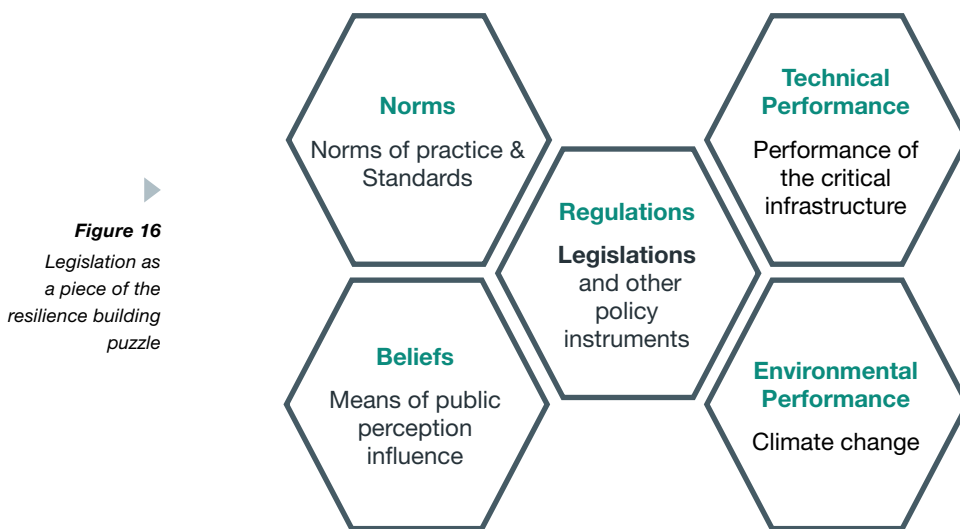
These could be further emphasised in future by the government, through mechanisms such as enabling community¹⁰.



Legislation as a piece of the puzzle

Several interviewees from the government portfolio departments and infrastructure owners/operators suggested that the legislation is not a singular mechanism for resolving the challenges associated with enabling resilience for infrastructure and communities.

This is supported by the work of O'Brien (2015), Hatton et al. (2019), and Keele and Coenen (2019) who note that there is no “silver bullet” in developing and selecting the suite of policy instruments that enable critical infrastructure resilience. Furthermore, these combined tools might be integrated with the technical features of the infrastructure system from the engineering perspective (Naderpajouh et al., 2018).



Different mechanisms work together to deliver overall resilience. For example:

- Legislation can be complemented with market-oriented mechanisms such as insurance policies or technological innovations such as the use of novel communication systems.
- It can also be complemented by cultural and lifestyle initiatives that create pressure from society such as the example of Emergency Management Victoria’s community resilience framework,¹¹ as initiatives on building resilience within the communities.

As a result, legislation can be more efficient if it integrates the existing mechanisms and combines with them to create synergies. For example, integration of existing industry standards, engineering practices, and risk governance practices with the legislation, norms of society, and beliefs, can substantially increase the public acceptance of initiatives that aim to increase resilience of communities and their infrastructure systems.



Legislation and policy are based on the building blocks of our collective experiences, and provide a rear view mirror into our past. Therefore, legislation and policy [alone] do not and will not cater for all facets of future emergencies, which by their nature disrupt our operating systems.

Kate Siebert, State Manager, Emergency Services, Australian Red Cross



**Challenges for future
legislation**

In producing this report, we have identified some future challenges that may be helpful to inform the future direction of any legislation in the field of critical infrastructure resilience.

Figure 17
Potential future challenges

Potential future challenges

INERTIA FOR CHANGE

Support activities that keep organisations flexible and receptive to required changes, rather than resistant

COSTS VS. BENEFITS

Balance the transaction cost of legislation, including compliance, enforcement and monitoring against societal, economical, and environmental benefits

COMPETING PRIORITIES

Understand the consequence of prioritising resilience investment over the long-term

RESPONDING TO A MOVING TARGET

Dynamic legislation, which revisits assumptions, is required to respond to the changing future uncertainty

INHIBITOR OF INNOVATION

Recognise the innovation inhibiting nature of legislation and actively promote practices that enhance flexibility and agility

SUSTAINING THE MOMENTUM

Sustain resilience momentum through establishing dynamic sector engagement, exercises and updated strategy

OVER-CONFIDENCE

Be aware that organisations may become overconfident in infrastructure systems resulting from the assurance generated by the legislation

How to avoid inertia for change?

Intuitively the impact of the legislation may flatten through time and reduce enthusiasm. A challenge can be perceived in the long-term to keep activities such as SRN meetings interesting or encourage organisations to explore the dimensions of risks critically and avoid routine revision of their Statement of Assurance each year. For organisations that are leading the market, the turning point of interest will start earlier and incentive mechanisms should be considered to encourage them to share their practice (such as recognition of their best practices).

How to articulate the costs versus benefits in the long-term?

For this purpose, the transaction cost of the legislation can be framed as costs associated with complying (for organisations such as infrastructure owners/operators), and with monitoring and enforcement (within the governing agencies). This can be considered as the transaction cost of creating certainty and establishing practice of resilience through legislative mechanisms. On the other hand, there are co-benefits associated with the legislation including the reduction of potential damages as well as reduction in insurance premiums. For example, one informant suggested that as a result of their proactive resilience approach, they have received discounts on their insurance. The proactive approach is part of the overall trend of the sectors in actions associated with resilience, in which the legislation is one element and instigator of change. However, as suggested by McGarity (1998), there is a peril of paralysis by analysis in the use of quantitative cost-

benefit analysis and there is a need for careful consideration of qualitative measures in assessment of legislations that often need to be weighed high in the decision-making process.

What is the long-term impact of prioritising resilience related actions over other competing resource requirements?

Legislation acts as a guideline for resource allocation and can change the priority of resource allocation. In these cases, it is important to observe the long-term opportunity cost of prioritisation resulting from legislation. Some competing priorities that may get discounted such as more regular condition assessment of assets may result in unprecedented impacts in the long-term.

How to frame legislations as a response to a moving target?

Social, economic and environmental uncertainties are rapidly growing and may result in a challenge for rigid requirements of the legislation. Therefore, there is a need for a dynamic approach to the legislation to respond to the new and transitioning norms. Emphasis on more integration of other mechanisms with the legislative approach can be an alternative solution to balance rigidity and need for flexibility. Legislators can observe these dynamics within the industry, learn from innovative practices of the infrastructure owners/operators, and integrate their practice within the legislative mechanism and associated processes (such as infrastructure owners/operators using the legislation as a leverage to get better service of interdependent infrastructure).

How to ensure innovative and agile responses are not inhibited by legislations?

Theoretically any legislation can be a barrier to innovative actions as it aims to establish practices (Gunningham and Sinclair, 2017). There are also, however, instances where legislations instigated innovation (such as the example by Tao et al., 2010). Whilst this study suggested the latter rather than the former (perhaps because the legislation is flexible, and focuses on enabling rather than enforcement), the legislating body should still be wary of instances that may lead to inhibiting innovative actions in the long term and aim for releasing the restraints if needed.

How to sustain the momentum and keep organisations interested?

There is a challenge that these new initiatives may become repetitive and individuals and organisations may lose interest.

As a result, there is a need for constant update of activities to keep the initial momentum and also establish incentive mechanisms to avoid complacency. This is especially important to ensure there is critical thinking behind the content of the documents rather than a routine 'copy and paste' from previous years.

How to avoid overconfidence that may emerge through enforcement of the legislation?

Legislators, organisations, and communities should be aware of that the positive aspects of a sense of assurance can also lead to over-confidence (see box : the 'levee effect'). Unjustified overconfidence on the performance of the infrastructure systems and their implications for the community resilience should be actively addressed.



Failed levee outside Hamburg, Iowa, U.S. (Photo by U.S. Army Corps of Engineers)

“THE LEVEE EFFECT”

Evidence from past disasters (such as Hurricane Katrina in New Orleans) shows that solutions which emphasise and strengthen engineering and infrastructure alone can be problematic as they may result in what is known as the 'levee effect' (Di Baldassarre et al., 2015 and 2018). Confidence on infrastructure system results in over-reliance on them and subsequently reduces community resilience (ref. to cases such as New Orleans, Sacramento, Netherlands, and Brisbane by Kates et al., 2006; de Moel et al., 2011; Ludy and Kondolf, 2012; Bohensky and Leitch, 2014).



Closing comments

This report highlights some of the benefits in practice associated with introducing legislated resilience requirements for owners and operators of critical infrastructure. The legislation builds on existing emergency and risk management practices, therefore changes are subtle and legislation was itself part of the transition.

- **Sharing knowledge** - There was an emphasis from our interviews on sharing of knowledge between organisations responsible for operating vital infrastructure within a sector, through attendance at, and contributions to, the Sector Resilience Networks, and through sharing information on risks and risk mitigations with the responsible government departments. This knowledge sharing, which is a mandatory component of the Act, led to an overall improvement in risk governance practice both within organisations and sectors.
- **Building understanding** - Transparency of practice, related to knowledge sharing, can lead to co-ordination of actions between organisations, and also a sense of assurance that others are committed to similar resilience outcomes. This means that different organisations across the wider critical infrastructure system have a shared understanding of the system's performance during emergencies beyond their own asset. The Act has assisted to remove some of the institutional, policy, cultural, procedural or financial silos that exist between organisations in the same sectors.
- **Increasing interaction** - We learned that the Sector Resilience Network meetings create a high level of reciprocity, where individuals volunteer to share their knowledge and experience. Furthermore, the creation of formal networks, primarily the SRNs, has been found to lead to the creation of informal networks and relationships which are critical for resilience.

The sense of assurance referred to above, where organisations have increased confidence in the behaviour of others both within and between sectors, means that **interdependencies between different sectors are addressed more directly**, and the management of interdependencies can be incentivised using the legislation to support requests for better levels of service from other organisations.

Appendices and references

Appendix I: Emergency Management Legislation in Australia

- The Ambulance Services Act 1986 governs ambulance services in Victoria.
- The Health Services Act 1988 governs the provision of quality patient care by health services. (the State of Victoria is currently reviewing the similarities between these two Acts (Department of Health and Human Services, 2016).
- The Country Fire Authority Act 1958 is another statute enacted by the Victorian Parliament that relates to emergencies which governs the volunteer and community-based Country Fire Authority (CFA). This Act does not encompass its specific purpose or objectives, but referring to the sections stipulates the powers, duties and responsibilities of various parties.
- The Metropolitan Fire Brigades Act (also 1958), merges the legislation relating to the Protection of Life and Property from Fire in the Metropolitan Fire. This Act is supported by the Metropolitan Fire Brigades (General) Regulations 2005 and the Metropolitan Fire Brigades (Contributions) Regulations 2009.
- Restructured from the Victoria State Emergency Service Act 1987 is the Victoria State Emergency Service Act 2005 which establishes the Victorian Emergency Service Authority to manage the Victorian Emergency Service. The State Emergency Service (SES) also provides support to Ambulance Victoria, the Police and the CFA. Under this Act is the Victoria State Emergency Service Regulations 2017 which dictates how the provisions of the Act are affected.
- The Emergency Management Amendment (Critical Infrastructure Resilience) Act 2014, and its related Regulations and Guidelines, which are the focus of this study.

Appendix II: Key definitions

Risk	The effect of uncertainty on objectives (ISO 31000). Risk can be further defined as the likelihood of a particular level of impact as a result of a potential situation
Risk governance	Risk governance is defined as the processes through which multiple actors deal with complexities, uncertainties, and ambiguities (Renn, 2017), and includes four stages of risk identification, risk assessment, risk mitigation, and risk communication (Bunting et al., 2007).
Resilience	Resilience encompasses the ability of systems to maintain their performance and/or adapt to a new regime of performance in response to changes in conditions (Hollnagel, 2016).
Resilience management	Managing desired output of systems under varying conditions (Naderpajouh et al., 2018).
Emergency management	The activities undertaken by the agencies to address a range of hazards (EMV, 2017)
Infrastructure systems	The network man-made systems that function together to provide essential goods and services for the societies (Marsh et al., 1997)
Critical infrastructure systems	Infrastructure systems that any interruption in their service will have a disruptive impact for the society (Marsh et al., 1997).

Endnotes

1. <https://www.resilienceshift.org/wp-content/uploads/2019/04/ResilienceShift-Role-of-Public-Policy-FINAL-1.pdf>
2. <https://www.emv.vic.gov.au/CommunityResilienceFramework>
3. <https://www.energy.vic.gov.au/safety-and-emergencies/powerline-bushfire-safety-program/reports-and-consultation-papers/victorian-bushfires-royal-commission>
4. A portfolio department is a minister's area of responsibility as a member of Cabinet. Within each portfolio there are one or more departments, agencies, government appointed boards, and/or other boards and structures. In Victoria the list of portfolio departments can be found at <https://www.vic.gov.au/departments>
5. When the Governor acts formally with the advice of the Executive Council
6. As with other aspects, participation in these arrangements is mandatory for owners of vital critical infrastructure and encouraged for major and significant infrastructure owners.
7. <https://gresb.com/gresb-infrastructure/>
8. See also 'The Journey of an Infrastructure Rating Scheme' <https://www.resilienceshift.org/isca-journey/>
9. See for example <https://www.resilienceshift.org/publication/critical-infrastructure-resilience-understanding-the-landscape/>
10. <https://www.emv.vic.gov.au/CommunityResilienceFramework>
11. <https://www.emv.vic.gov.au/CommunityResilienceFramework>

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