SHOAL™

PROTECTING CRITICAL INFRASTRUCTURE AND SYSTEMS OF NATIONAL SIGNIFICANCE

A FRAMEWORK FOR NATIONAL RESILIENCE

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INTRODUCTION

The Department of Home Affairs has sought input on the details of the Government's reforms regarding the security and resilience of critical infrastructure through the Protecting Critical Infrastructure and Systems of National Significance.

The following sectors are noted by the Department of Home Affairs as comprising the critical infrastructure sectors:

- Banking and Finance
- Communications
- Data and the Cloud
- Defence industry
- Education, Research and Innovation
- Energy
- Food and Grocery
- Health
- Space
- Transport
- Water.

In the recent past, Shoal Group has made three submissions on the topic of national resilience to Federal and State Government inquiries, namely:

- The Senate Select Committee on COVID-19
- The Joint Standing Committee on Foreign Affairs, Defence and Trade Inquiry into COVID-19
- The Victorian Government Discussion Paper into the Victorian Ports System.

Each of these submissions has addressed the concept of national resilience. Protection of critical infrastructure and systems of national significance is a fundamental part of resilience. The factors outlined by the Department essentially fall into the categories addressed in these earlier submissions, namely:

- Continuity of **government** – requires the ability to choose and to conduct free and fair elections
- A capable and functional **defence force** – necessary for deterrence and for defence. In turn, this depends on defence industry capabilities.
- Provision of **energy** in a reliable and sustainable manner
- A capable and functioning **health** system
- Ongoing provision of **food** and **water**
- A functioning **telecommunications** network, with a high level of **cyber protection**
- Robust **transportation** systems.

This submission is structured in three parts, namely:

1. An overview of the approach to, and the benefits from, constructing a Model-Based National Resilience Framework
2. Answers to specific questions from the Consultation Paper
3. Related matters.

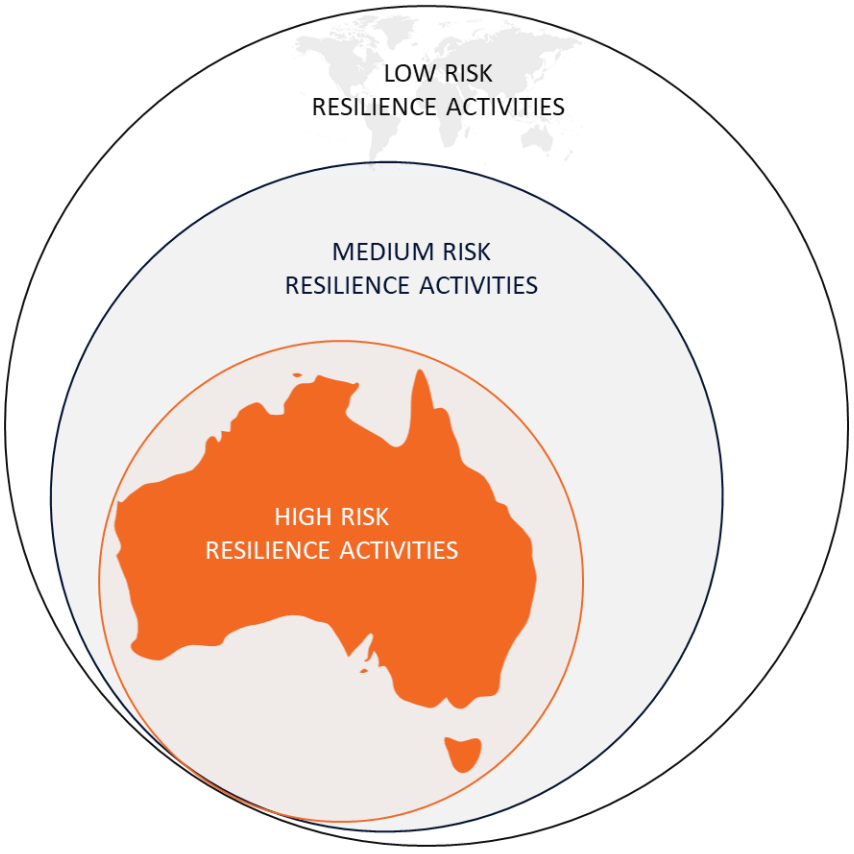
PART ONE

A risk-based approach to national resilience

A risk-based approach to national resilience would see resilience activities, including supply chains, broken down into three categories. The first must be those associated with high risks – those goods and services that we must control from within Australia, as not to do so would expose us to totally unacceptable risks – existential risks. Addressing these risks cannot rely upon anyone else – not even the closest of allies, and solutions are not going to develop through a reliance on market forces. The Government needs to control and directly manage developments in this category.

The second category are those goods and services that are of medium risk – not potentially existential, but of sufficient concern that we cannot just rely upon market forces, and certainly not on authoritarian governments or easily-interdicted supply chains for their provision. The management of developments in this category would be through a close partnership between the public and private sectors.

The final category is comprised of low risk goods and services. In this case open, market-driven, global supply chains are acceptable, as we have made the determination that the risks are low. This does not mean that we just forget about items in this category. We need to understand the supply chain and, importantly, changes in those supply chains, to determine if / when they cease to be low risk and become something else.



Applying decision frameworks to National Resilience

With such a high level of complexity across the Australian society, and when considering each element of critical infrastructure as a system within a system, a methodological approach to developing a Resilience Framework develops from a **Systems Thinking** perspective. Systems Thinking, and the range of associated methodologies, tools and frameworks, provide an insight into how a Resilience Framework can both be constructed and applied in practice.

Decision Frameworks are diverse and vary in their application and, at their core, are designed to facilitate robust and contestable decisions. They include aspects such as problem definition, strategic goals, planning and observations, and provide a conceptual, or abstracted view, of the issues and insights that inform decision making. Structuring, or codifying these conceptual and integrated aspects, provides a richer picture to the decision maker.

Decision Frameworks give structure to the information, integrating multi-disciplinary domain knowledge, thereby enhancing the understanding in the decision maker. Decision Frameworks, based on systems thinking, support policymakers to understand the multi-domain and interrelated consequences. At Shoal, we employ model-based frameworks to improve our designing of resilient and elegant solutions to complex problems, whether they are physical, organisational, or societal. They provide us with three main outcomes:

1. They facilitate the exploration of options and capture decisions, with rationale
2. They integrate information from across multi-disciplinary domains
3. They enhance our knowledge transfer, providing a current and common understanding such that the knowledge from the mind of the producer (analyst) can be easily transferred to the mind of the consumer (decision maker).

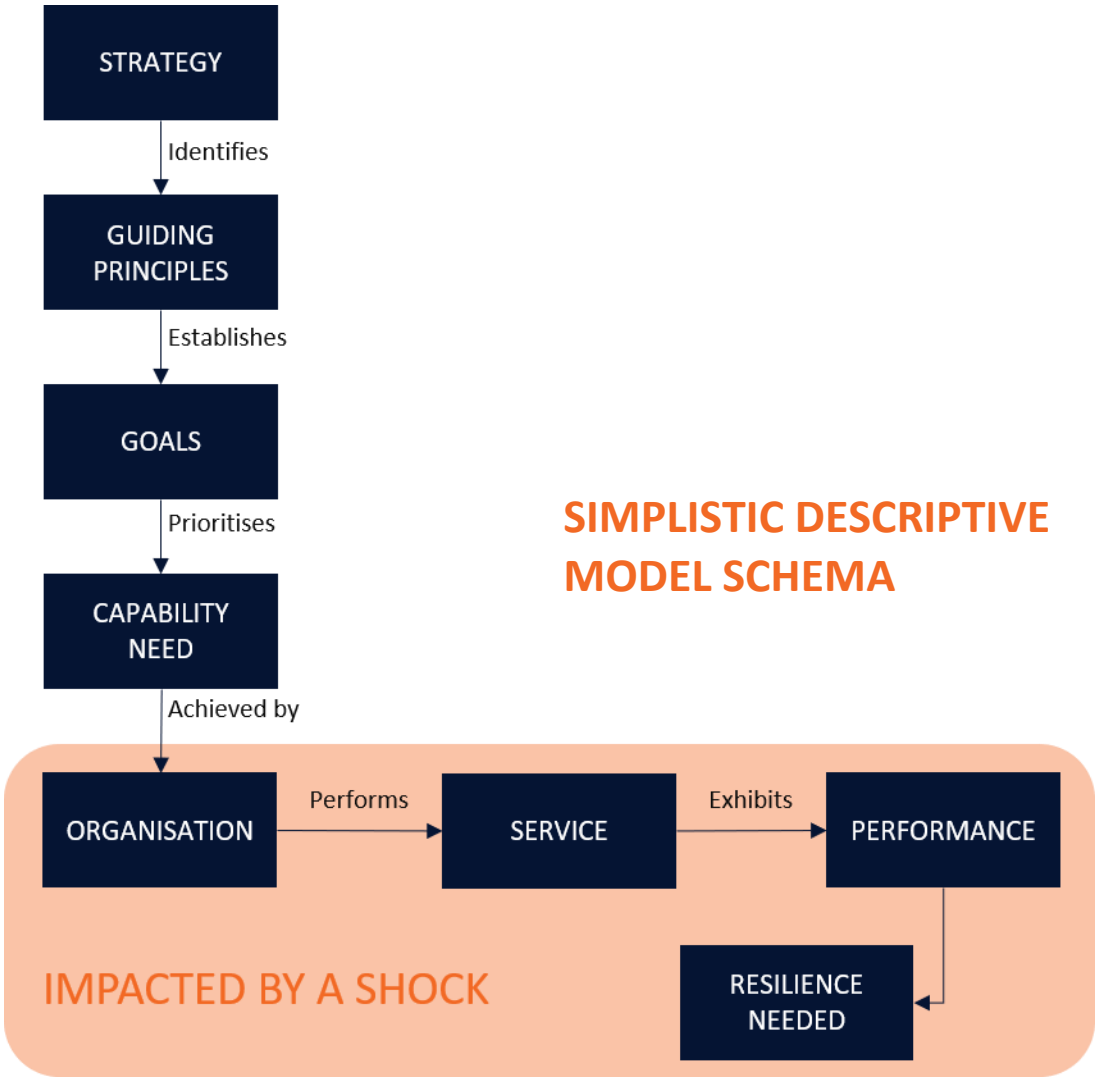
Decisions Frameworks have common principles, processes, and practices that enable information and analysis to inform decisions. They identify the problem, support the capture and analysis of information and build the knowledge towards informing decisions across all aspects of society. If we are to develop a Resilience Framework for the protection of critical infrastructure, we must capture the relationships between the various components within society in order that the most effective decisions can be made. A well-structured, model-based decision framework (derived from systems thinking) can allow us to achieve this and deliver the robust and contestable decisions we need.

A model-based approach to national resilience

Regardless of the approach taken to decision frameworks (and there are many), there is a need to codify these high-level conceptual guiding principles and goals, and relate, or trace, them to the analytical detail of interrelationships and activities at the implementation level. In other words, provide a digital thread of logic, from strategy to implementation. This 'digital thread' codifies the information and decision rationale to deliver the robust and contestable decisions we need.

As a simplistic example, consider the following thread of reasoning and logic:

- A strategy identifies guiding principles
- Guiding principles establishes goals
- Goals prioritise capabilities needed
- Capabilities needed are achieved by an organisation
- An organisation performs a service
- A service exhibits a performance
- Performance includes a level of resilience needed.



This simplistic underpinning schema, or ontology, serves two purposes. The first is that it reinforces the potential extent of a potential shock event, and therefore the importance of having a resilient approach to that event. The second is that it categorises the information classes of the problem of interest and provides the structure that delivers a decision framework. This can then be used for robust and contestable decisions. The structure in the schema is utilised to capture the instantiations of the real-world information of the problem, in a 'descriptive model'. The instantiated descriptive model provides the analyst and decision makers with the visible knowledge at their fingertips to gain the insights from a digital thread of logic and reason over issues such as the impact of a shock or viable solution options.

The challenge with the complexity of 'wicked problems', such as enhancing the ports resilience strategy, is that some **Systems Thinking** tools cannot be stretched to robustly cover all aspects of the problem space. As considered by George Miller, from Harvard University, in his 1956 paper in the Psychological Review, that is still relevant today, we limit our "…judgments to about seven categories." This is where a well-structured descriptive model can help. The structure allows for the decision maker to focus on a single digital thread of reasoning and only visualise the aspects needed to make the decision, whilst being informed on the broader issues. Other tools, that aren't model-based, quickly become unacceptable for supporting the decision making when they extend beyond tens of components and relationships. This is the level of complexity that we expect with a National Resilience Framework.

A model-based decision framework enables better decision making by providing a structure and hence bringing clarity to the interconnectedness of cross domain problems and solutions. This is even more important for decisions around building resilience, where Government investment is required, and funding will be finite. It will deliver a 'rich picture' of an appropriate sub-set of information to the decision makers providing the digital thread of rationale that realise contestable decisions. We will know the impact of a 'shock' on the system, because the model will draw the digital thread of *cause* and *effect* throughout the system, and the *system of systems* in which it lives ie. the relationship between the infrastructure sectors identified by the Government.

The model would build on existing regulatory frameworks and consider the relationships between them. The model would ensure that any inconsistencies are identified and hence able to be resolved. The model will not result in multiple duplicates of the same information as a single point of truth would be developed.

A model can be as broad and as detailed as required for particular circumstances, or in specific areas. A model that incorporates high fidelity data in one area, for example transportation, with lower fidelity in another, for example energy, is possible. Additional sectors and/or higher fidelity information can be added as it is required or becomes available. Modelling will enable better decision-making in a highly complex environment as the relationships and dependencies can be modelled, and a single point of truth can be developed.

PART TWO

Addressing specific questions within the consultation paper

Question 1 - Do the sectors above capture the functions that are vital to Australia's economy, security and sovereignty? Are there any other sectors that you think should be considered as part of these reforms (e.g. manufacturing)?

In addition to the sectors above that are vital to Australia's economy, security and sovereignty, Shoal proposes the addition of the following:

- Continuity of government – requires the ability to choose and to conduct free and fair elections
- A capable and functional defence force.

The suggestion that manufacturing be included cannot be supported, although there will be elements of manufacturing that will be critical elements of the categories noted. A topical example would be the manufacture of some pharmaceuticals and health-related equipment within the Health category. A model-based approach to national resilience as proposed herein would be useful in identifying these critical elements.

Question 3 - Are there factors in addition to interdependency with other functions and consequence of compromise that should be considered when identifying and prioritising critical entities and entity classes?

The categories noted above will all be interdependent. Transport, for example, will be critically linked to Food and Grocery in getting produce from the farm to the point of sale. Transport will also be a key factor in fuel security, and in health. Energy is linked to all categories. That's why a model-based approach to defining the set of infrastructure assets and systems will better evidence the linkages.

It will also be important to understand the second and third order effects of these interdependencies and, as not all interdependencies will be equally weighted, the various relativities that apply.

One other factor will also important, namely the way that the interdependencies and associated relativities vary over time as circumstances, organisations, policies and technologies change. The ability to incorporate these changes in a timely, efficient manner will be crucial in having a resilience framework that it itself resilient.

The understanding of these relationships and interdependencies is a critical factor in addressing resilience and the protection of critical infrastructure in a holistic manner. A model-based approach to resilience and critical infrastructure protection will illuminate these relationships and, importantly, serve as a single point of truth for decision-making.

Question 5 - How should criticality be assessed to ensure the most important entities are covered by the framework?

Criticality is associated with risk. That is, the risk that the economy / society will cease to function or will suffer significant degradation in the event of compromise.

Not all identified elements will be deemed to be equally critical, so the assessed criticality will vary according to a particular situation.

The key therefore is to undertake a mapping of sectors and activities to risk in order to categorise and therefore prioritise the investments that will need to be made. In some instances, a key risk may develop across sectors and/or from lower level activities that may not be immediately obvious. A model-based approach to a national resilience framework will allow these relationships and dependencies to be identified by running a series of critical infrastructure protection and national resilience scenarios.

Question 8. What might this new TISN model look like, and what entities should be included?

The Trusted Information Sharing Network (TISN) model needs to mirror the construct of the National Resilience Framework, and include the entities noted in that Framework.

Entities should be involved according to the criticality of their activity, with high risk sectors have a closer and more continuous engagement than sectors with lesser risk profiles.

Questions 9. How else should government support critical infrastructure entities to effectively understand and manage risks, particularly in relation to cross sector dependencies? What specific activities should be the focus?

The answer to Question 9 lies in:

(1) The determination and categorisation of risks

(2) The construction of the National Resilience Framework in order that cross sector dependencies and relationships can be fully explored, described and managed.

The focus of activities will derive naturally from the categorised and prioritisation of risk areas, and from the dependencies and relationships between sectors.

Question 15. Would the proposed regulatory model avoid duplication with existing oversight requirements?

A model-based approach to the development of a national resilience framework would any potential for duplication by ensuring that a single point of truth was developed and maintained.

PART THREE

Related matters

Two things are certain from the current environment.

The first is that the current and future crises will see impacts develop on the port system, its infrastructure and operations that are currently unforeseen. In some cases, rapid decision-making may be required, and those decision makers needs the best information on which to make their decisions. Furthermore, given the complexity of the ports system, those decisions need, as far as possible, to avoid unwanted and / or unforeseen consequences.

The second certainty is that there is always room for improvement. That is, the way in which infrastructure sectors are managed may benefit from a targeted, more nuanced, approach to decision making.

Reframing our future by introducing a Critical Infrastructure Resilience Framework is critical to understand and codify the complex inter-relationships between functional areas and activities, and to prioritise the Government's response efforts. This structured, codified, 'model-based' framework would allow the capture and implementation of the factors affecting resilience, and the categorisation of their relationships and interactions. A model-based framework would enable structured analytical testing (contestability) and the addition and amendment to relationships and interactions as additional data and lessons become available without the overhead and delay associated with unstructured document-based plans.

Shoal Group is working on the development of such a framework as an extension to the work that we have typically achieved in understanding complex and future defence scenarios, and we would be pleased to discuss this further with the Review.