



SHOAL™

WHITE PAPER VICTORIAN PORTS SYSTEM

RESPONSE TO DISCUSSION PAPER JULY 2020

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A PORT IS A COMPLEX SYSTEM OF SYSTEMS

The Victorian ports system has continuously evolved to become a series of four commercial and 14 local ports across Victoria today. They are on the front line of Australia's international trade and border protection:

- Receiving and distributing agricultural commodities and manufactured goods around the globe
- Servicing commercial fishing, boat repair and ferry sectors
- Supporting the oil and gas industry
- Enabling marine pollution preparedness and response.

But the Victorian ports system does not operate in isolation to achieve this. It is, in fact, a system within a system, providing the interface between the world and Australian society and supply chains. It is critical for the functioning of both the Victorian and Australian economy, to achieve the State's objective "to serve the needs of Victorian citizens, businesses and the economy by providing convenient, efficient access to international and interstate shipping services and coastal resources¹."

Therefore, it is important that ports conduct their activities safely, efficiently and effectively, having the resilience to withstand interruption and the ability to thrive to deliver to the suggestion vision for the Victorian ports system.

¹ Page 19, independent review of the Victorian ports system, Ports discussion paper, Department of Transport, 2020

PORTS AND NATIONAL RESILIENCE

The proposed vision for the Victorian ports system is to be:

- A national leader
- Innovative
- Safe and environmentally responsible
- Well planned and integrated
- Collaborative and constructive
- Understood and supported².

A key element missing from this vision is that of **national resilience**.

Resilience is the ability of a system to firstly resist the misfortune, or shock, and then to recover from the shock-induced drop in performance and re-attain the original performance or better. The word **resilience** is derived from the Latin verb 'resilire', which means to 'recoil'. When you think of this in terms of a spring, recoiling is to return to its original form. For another definition, we can look to Merriam-Webster's online dictionary. It provides two definitions of resilience that are broadly similar, except that they diverge through the perspectives of the physical and functional aspects of systems:

1. Physical

The capability of a strained body to recover its size and shape after deformation caused especially by compressive stress

2. Function

An ability to recover from or adjust easily to misfortune or change.

The current COVID-19 pandemic has exposed elements of Australian society with respect to our ability to operate, indeed survive, through a concentrated period of national disruption, challenging the resilience of our economy and systems. Whilst the current situation originated as a health crisis, it rapidly developed into an economic crisis and highlighted the importance of understanding the nature of the relationships between elements of the Australian society and the associated vulnerabilities. In that sense it has also become a social crisis.

The current crisis, therefore, provides an opportunity to assess these vulnerabilities and to also consider, at the strategic level, the vision for Australia as we move into a new reality. In this way, we can build a stronger, more resilient nation, and be better prepared when the next crisis develops.

² Page 20, independent review of the Victorian ports system, Ports discussion paper, Department of Transport, 2020

Resilience can be addressed through concentration on a small number of factors, determining how they inter-relate and, hence, having a picture, a model, of this inter-connectedness. At the macro level these factors can be considered as:

- 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.

All of these factors are inter-related and all depend on additional inputs from other areas within society. The Victorian ports system, for example, not only rests on being part of a robust **transportation system** but is also integral in the provision of **food** and **water**, **energy** and a provider to the **Australian Defence Force**. As such, it is a system within a system, and underpins the resilience in many of these areas.

QUESTION 1:

- a) Do you think the suggested vision statement above captures the key desirable attributes of the Victorian ports system?
- b) How would you change or improve it?

ANSWER:

The suggested vision statement mostly captures the key desirable attributes of the Victorian ports system.

The vision could be improved by the inclusion of the concept of resilience, at both the State and National level, to emphasise the importance of the ongoing functioning of ports system.

STRATEGIC PLANNING TO ACHIEVING RESILIENCE

We want to be able to withstand a future pandemic or shock inducing event. We want to be a resilient society. To do so, we need functioning and efficient ports, and hence we need to consider risk in any Port Development Strategy (PDS).

A risk-based approach to Resilience would include ports resilience and see activities associated with resilience broken down into three categories:

1. High risk

Those activities, 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.

2. Medium risk

Those activities, goods and services that are not potentially existential, but of sufficient concern that we cannot just rely upon market forces or easily interdicted supply chains for their provision.

3. Low risk

In this case open, market-driven, global supply chains are acceptable, as we have made the determination that the risks are low.

The categorisation of activities within the various commercial and local ports throughout Victoria would likely differ, depending on their supply chain, service areas, stakeholders, customers and asset state. Three key elements for government policy arise from this allocation:

1. Vary policy according to risk

High risk activities, products and services are likely, in the near term, to require government investment to establish the relevant domestic capability – given that in many cases these are unlikely to currently exist in the requisite form. In the longer term, government monitoring and management is going to be required, as high risk activities, products and services are likely to change over time as the political and economic situation changes, as technology, corporation ownership and port organisation changes, and as the Victorian and wider Australian society changes. Whilst medium risk and low risk categories will require levels of investment commensurate with the risk, that is less investment as the risk reduces, ongoing review will be required to account for the changes as outlined above.

2. Extent

The second issue relates to extent. Given that resilience covers a wide swathe of inter-related societal factors it will not be acceptable to stove-pipe the policy settings required into the familiar, existing departmental structures. It will be important to understand these relationships and the flow-on effects across the economy, and across society, of particular actions.

3. Ports resilience framework

The third issue, that flows directly from the second, is that a ports resilience framework for the Victorian ports system is required. Such an approach should be capable of integrating seamlessly into a State-based or National Resilience Framework. The Framework must capture the relationships between the various components that comprise a port, that comprise the ports system, and that comprise the interactions between that system and the wider Victorian and Australian society in order that the most effective decisions can be made. A framework gives decision makers a tool to identify relationships and adjust levers and see the cause and effect implications of each.

Ports as a *system of systems*

A port is a complex **system of systems** that can be considered in a variety of ways, one of which comprises, *inter alia*:

- Operations, that in turn comprises:
 - Shipping – including vessel movement and navigational safety
 - Channel clearance, including hydrographic operations and dredging operations
 - Pilotage
 - The provision of berths and facilities
 - Services and telecommunications
 - Cargo loading and unloading
 - The movement of cargo into and from the port area, including storage
 - Road and/or rail connections into the port
- Port management, that includes:
 - Management of port services and financial management
 - Cyber protection
 - Protection and safety of personnel within the port
 - Emergency management, both onshore, ship-based and maritime emergency management such as oil spill
 - Environmental management
 - Asset management
 - Port strategic planning and development
 - Application of State and Federal regulations
 - Liaison with external State and Federal authorities such as fire and police
- Port protection and security that includes:
 - Waterside security – including tracking of vessels within the port environs and the approaches
 - Landside security – including physical security of the port area and access control
 - Immigration
 - Customs
 - Quarantine
- Sharing the Port space, that may include:
 - Utilisation of port spaces and approaches for community activities such as recreational sailing and fishing. This may be particularly relevant for the Port of Melbourne and for Geelong. The scale and sites for these activities will vary according to the time of day and the year. There may be benefits in determining how these activities vary in order to develop a normal pattern of leisure behaviour
 - Cruise ship operations
 - Visits by naval shipping, both Australian and international navies

In the Victorian situation, the ports of Melbourne, Geelong, Hastings and Portland, together with the local ports across the Victorian coastline, also operate as a system. This system has common stakeholders with interests across each of the ports, and local stakeholders whose interests are centred on a single or a small number of ports.

A further level of complexity relates to the interaction of the port with the external community. Each port has individual interfaces with these communities, interfaces that will include the potential impact of port operations, such as the movement of cargo in to and from the port, on normal life in each community. The management of these interfaces may, in some cases, be undertaken on a holistic basis. Others will require planning and action on an individual basis.

Understanding decision frameworks

With such a high level of complexity across each Victorian port, and when considering Victorian ports 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).

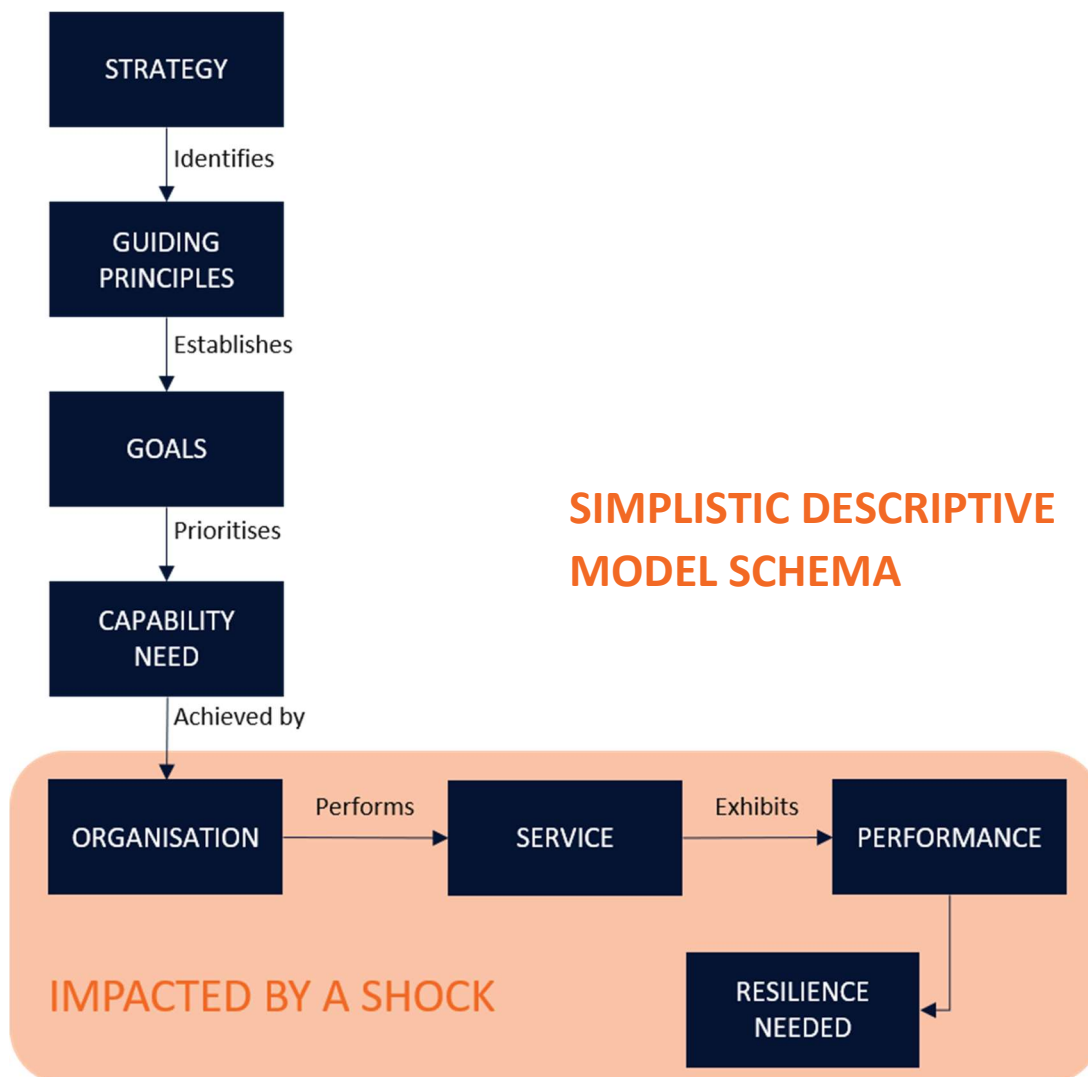
Decisions Frameworks have common principles, processes, and practices that enable information and analysis to inform decisions. They identify the problem, support the capture and analysis of information and build the knowledge towards informing decisions across all aspects of society. If we are to develop a Resilience Framework for Victorian ports, 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.

Ports and planning

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, 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.

Better decisions.

Particularly around prioritising available resources to maximise the value of the investment.

Expertise and an understanding of the ontology of problems is important in framework design. How decisions are made, and information and rationale must be captured in descriptive models by experienced systems engineers to support development of a Resilience Framework for robust and contestable decisions.

QUESTION 13:

- a) What is your view of the value of the requirement for commercial ports to prepare PDSs? Do you think the current process for preparing PDSs is effective? What changes/improvements would you make, if any?
- b) Who do you think should be responsible for preparing PDSs, given that there are usually multiple bodies involved in the management of the port land and waters? Would you make any changes to current responsibilities? Please explain?

QUESTION 14:

- a) Would you like to comment on the need for and role of a new Victorian Ports Strategy? What key content areas should it cover?
- b) If you had to nominate the three most pressing strategic issues that a new strategy should address, what would they be?

ANSWER:

The requirement for ports to prepare PDSs is imperative in ensuring that Victorian ports achieve the vision, particularly resilience. Developing a framework upon which to collect, link and relate various information elements will also be imperative.

Evidenced-based decision making across the entire system of systems that comprise Victorian ports will be important for planning, and in addressing future crises that might develop. Such decisions need to appropriately balance what might be competing or contradictory actions. The gathering and presentation of all the factors, their relationships, and an understanding of the various impacts on different parts of the entirety of the system, and in each subsidiary system individually, will be critical in optimising future responses.

Systems Engineers can make a real contribution to enable strategy and support change. It plays an important part in managing stakeholder engagement and providing the digital thread from each party, an especially important consideration for Department of Transport and each of your port jurisdictions in developing their PDS. By modelling the systems and their interrelationships, we can integrate and analyse information across multi-disciplinary domains to inform decision making and enable strategy.

If Victorian ports are to be addressed as a system of systems, and that PDSs address the issue of resilience, it is important that the following occur:

- A structure for the capture of information be developed at the system of system level. This structure needs to identify both the type and fidelity of the information to be captured, with clear definitions and descriptions of entities within the system, in order that the PDS for each port separately can be aggregated at the all-of-Victoria level. This level should be the responsibility of the DOT, or some other body that might be established to address all aspects of resilience.
- The PDS for each separate port be developed in a consistent manner. This level is the responsibility of each port separately

RELATED MATTERS

Two things are certain from the current situation.

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 need 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 the ports systems is managed may benefit from a targeted, more nuanced, approach to decision making.

Reframing our future by introducing a Ports 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.

QUESTION 16:

- a) What role do you think Victorian ports or the ports system as a whole could play in strengthening the coastal shipping industry?
- b) Do you agree that this matter is best progressed through the development of a Victorian ports strategy later in 2020? If not, please explain.
- c) Are there any initiatives you think could/ should be pursued in Victoria separate to, or ahead of, work on the ports strategy? Please explain.

ANSWER:

The development of a ports strategy that includes resilience will directly identify the part that coastal shipping plays in the provision of a resilient society. The strategy will also highlight both the need and the scope within the system for the strengthening of coastal shipping. Furthermore, a model-based approach to strategy will identify the relationship within, across and external to the ports system, and the types of development that might improve that system. Importantly, a model-based resilience framework will allow for different scenarios to be “war-gamed” with a view of making the optimum decision.

QUESTION 17:

- a) Do you think there is a need for a formal, standing industry consultative body to provide the Minister and/or relevant government agencies with advice on ports system issues and priorities?
- b) If yes, what form should this body take in terms of role, membership, operation, etc.?
- c) Would it be better to incorporate ports system issues within a broader freight and logistics industry consultative body?.

ANSWER:

Given the number of stakeholders in the Victorian ports system it is clear that consultation with industry is a requirement. Moreover, these stakeholders will have a valuable role in determining and categorising the relationships between entities and activities across the system to provide the best model of that system.

There is a danger in establishing a ports-only consultative body as ports are a complex system that do not operate on their own. Resilience will only come by considering all the important factors that impact, and in that sense a wider consultative body that included the logistics community would be useful.

ABOUT SHOAL

At Shoal, **we seek an improved world as a result of tackling the most challenging problems.** This vision inspires us every day and drives our ambition as leaders in systems thinking.

Systems thinking is at the heart of everything we do.

We use it to clearly define the complex problems you are facing, whether you are developing new capability, introducing new technology or seeking a better way to manage your assets and resources.

We use it to support, manage and deliver big projects, in complex environments; the kinds of projects that you dream of, but then have nightmares trying to figure out.

We use it to analyse complex situations and problems, through robust decision frameworks and modelling, and therefore help you to understand and find solutions to these problems.

The projects that we work on often have lots of moving pieces that are interrelated and technically challenging, so we use a rigorous, systems engineering approach, based on best practices gleaned from around the world (amongst which are our own). When we do this, all the pieces of the system come together to enable and equip you with the information that they need to:

- Make better decisions
- Manage resources
- Develop capability
- Adapt
- Avoid risks
- Achieve objectives.

Founded in 2001 and headquartered in Adelaide, our team extends across Australia, New Zealand and North America.