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The business case for resilience in infrastructure and continuity of function

O caso de negócios para resiliência em infraestrutura e continuidade de função

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Abstract

Resilience, like security, can be difficult to define and can mean many things to many people. In general, resilience may be defined as the ability to prepare and plan for, absorb, recover from, and more successfully adapt to actual or potential adverse events. Different aspects of systems resilience have been published setting the stage for implementation; however, a clear business case for resilience is lacking. Resilience, like security, requires on-going effort and represents more a way of thinking than the application of a specific tool or technique. Within the leadership and senior management of a State Department of Transportation (SDOT) the subject of resilience is especially important, but like communications it is very easy to discuss but very difficult to effectively implement. In an era of shrinking budgets and pressures to reduce headcount each investment of scarce resources must be justified on a return-on-investment basis. Thus, the business case for resilience must be made. Fortunately, resilience is a process that is entirely scalable and includes both long-range and intermediate planning. It is applied enterprise-wide and within individual business areas that may or not be supported by funded policies. The purpose of this paper is to discuss a process for development of a business case for resilience in infrastructure and continuity of critical function based on literature review and experts' practice. Risk analysis, identification of resources, and mainstreaming (implementation) techniques are included.

Keywords: Resilience; Security; Infrastructure.

Resumo

A resiliência, tal como a segurança, pode ser difícil de definir e pode significar muitas coisas para muitas pessoas. Em geral, a resiliência pode ser definida como a capacidade de preparar e planear, absorver, recuperar e adaptar-se com mais sucesso a eventos adversos reais ou potenciais. Foram publicados diferentes aspectos da resiliência dos sistemas, preparando o terreno para a implementação; no entanto, falta um argumento comercial claro para a resiliência. A resiliência, tal como a segurança, exige um esforço contínuo e representa mais uma forma de pensar do que a aplicação de uma ferramenta ou técnica específica. Dentro da liderança e da gestão superior de um Departamento Estadual de Transportes (DET), o tema da resiliência é especialmente importante, mas tal como as comunicações, é muito fácil de discutir, mas muito difícil de implementar eficazmente. Numa era de orçamentos reduzidos e de pressões para reduzir o número de funcionários, cada investimento de recursos escassos deve ser justificado com base no retorno do investimento. Portanto, o argumento comercial para a resiliência deve ser apresentado. Felizmente, a resiliência é um processo totalmente escalável e inclui planeamento de longo prazo e intermédio. É aplicado em toda a empresa e em áreas de negócios individuais que podem ou não ser apoiadas por políticas financiadas. O objetivo deste artigo é discutir um processo para o desenvolvimento de um business case para resiliência em infraestrutura e continuidade de funções críticas com base na revisão da literatura e na prática de especialistas. Estão incluídas análise de riscos, identificação de recursos e técnicas de integração (implementação).

Palavras chaves: Resiliência; Segurança; Infraestrutura.

The percieived cost of resilience

Different aspects of systems resilience have been published setting the stage for implementation; however, a clear business case for resilience is lacking. Resilience in the DOT leadership sense requires on-going effort and represents more a way of thinking than the application of a specific tool or technique. The figure at right (Figure 1) is a visual representation of this reality.

Figure 1

Resilience, like security, in transportation can be difficult to define and can mean many things to many people. In general, resilience may be defined as the ability to prepare and plan for, absorb, recover from, or more successfully adapt to actual or potential adverse events. A business case approach is necessary to support resilience solutions and should include visualization tools to help evaluate, identify, and communicate the needs, vision, and benefits. Most SDOTs have some level of understanding, and likely already have some initiatives in place for resilience and security of infrastructure. The business case and communication for this purpose, however, must consider many federal level requirements such as the:

- 2022 Bipartisan Infrastructure Law
- 2015 Fixing America's Surface Transportation Act (FAST Act), the
- National Highway Performance Program (NHPP), and the
- 2012 Moving Ahead for Progress in the 21st Century Act (MAP 21) and related policies.

Mainstreaming a comprehensive resilience approach requires partnership

with local and regional organizations to identify system bottlenecks that will impact infrastructure and critical government function alike. The resources required to recover from disruptions in these two arenas can quickly outsrip the capacities of any single agency or even level of government. The resilience-in-a-box product presented here is the result of a collaboration between the Alabama Transportation Institute and Metro Analytics and represents a way of thinking as much as a set of developed tools to support SDOTs and other transportation agencies as they evolve their resilience and security systems in the form of a compelling business case.

The research methodology used to support this work included both the literature review and experts' practice who have to produce resilient outcomes to infrastructure and the built environment and human processes for both the government and the public.

The process

The process developed has three stages:

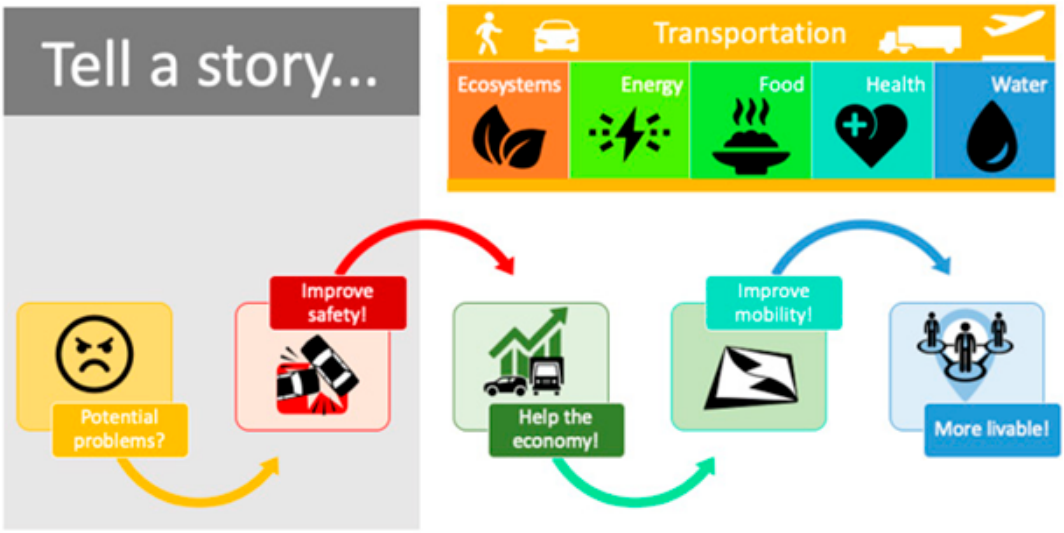
- **Stage 1 – Definition of Resilience and Identification of Measures:** As stated above, resilience means many things to many people. The first step includes an analysis of the SDOT to define resilience and design goals and objectives.
- **Stage 2 – Risk Analysis and Program Development:** Risk analysis for an SDOT is a particular challenge as most SDOTs are self-insured and unfamiliar with thinking of risk tolerance through the lens of resilience. This is an area of significant research need. Once the risk threshold is established, however, the resilience program is developed with the analysis and design from the previous stage bracketed by the risk analysis of this stage.
- **Stage 3 – Mainstreaming the Resilience Program:** The analysis, design, and development of a program does not guarantee its implementation. Mainstreaming a resilience program includes the marketing of the program to key internal and external stakeholders, creation of intergovernmental and public/private partnerships, and integration of the program into existing policy frameworks.

First Stage: Resilience Analysis and Design

The effort begins with an analysis of the Strengths, Weaknesses, Opportunities, and Threats (SWOT) attributes for the SDOT's resilience and security efforts. This information is organized into:

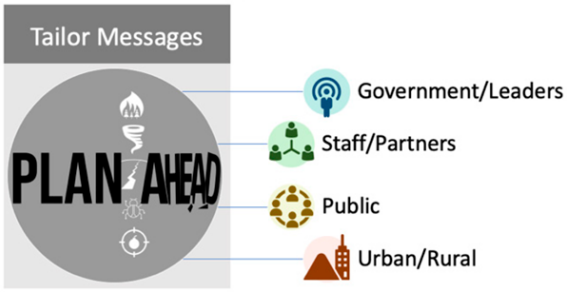
- **Performance Strategies:** Which includes strategies to benchmark communication success and identify needs based on those benchmark characteristics.
- **Partnership Strategies:** Which includes both inter-agency and intra-agency strategies.
- **Business Case:** Which describes the risk tolerance of the SDOT in terms of the costs of disruptions against the costs of preparation, and
- **Communication Plans:** That identify how the business case is effectively communicated, the purpose of the communication plan(s) is to tell the story that compels the commitment of appropriate resources to the resilience/ security effort. An example of this is depicted graphically in Figure 2 below.

Figure 2



The communication plan is be customized for the stakeholders involved in the given effort. Each communication plan carries a tailored message with technical detail and language for the stakeholders involved considering the political realities of the place and time, the characteristics of the internal partners, the general public, and the geography (urban vs. rural) as illustrated in Figure 3 to the left.

Figure 3



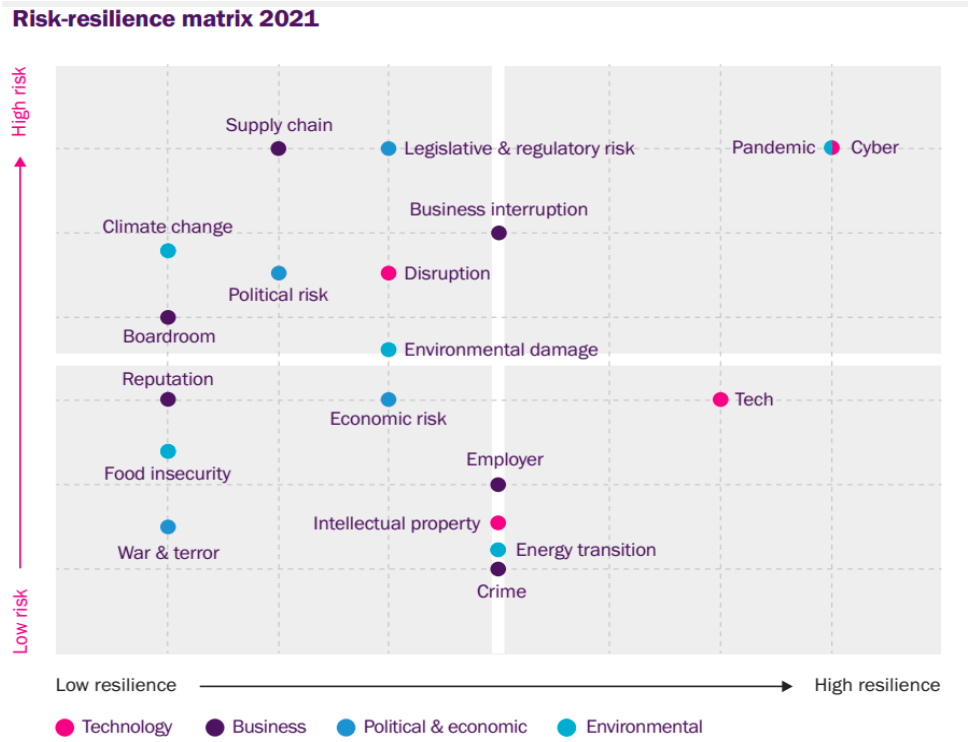
Second Stage: Risk Analysis and Program Development

At its core, the purpose of this process is to facilitate conversations that are designed to shape the products that have the highest value for the SDOT. The business case features the highest-value products through the framing of the following discussion questions:

- Where are the critical infrastructure elements?
- Where are the areas with zero redundancy?
- Where are the triage plans for reconstruction of critical infrastructure?
- Where are the locations for staging of rescue and recovery?
- How are they served?
- Where are the plans for calling upon multiple agencies for support?

The concept of risk analysis is not new. SDOTs have long been familiar with risk analysis in the legal arena, the safety arena, and others. The concept of risk analysis in resilience is, however, unfamiliar territory. The insurance industry has long made a practice of risk analysis and examples such as the Beazley Risk-Resilience Matrix 2021 (as depicted in Figure 4 below) provides a framework for post-pandemic risk analysis in the insurance industry.

Figure 4



As discussed above, however, most SDOTs are self-insured, and a defensible and reliable process by which an SDOT may properly assess their risk tolerance is a significant research need. This is a vital step in the development of an SDOT resilience program, and as the case study below describes, it can be a source of considerable debate.

Building the Business Case

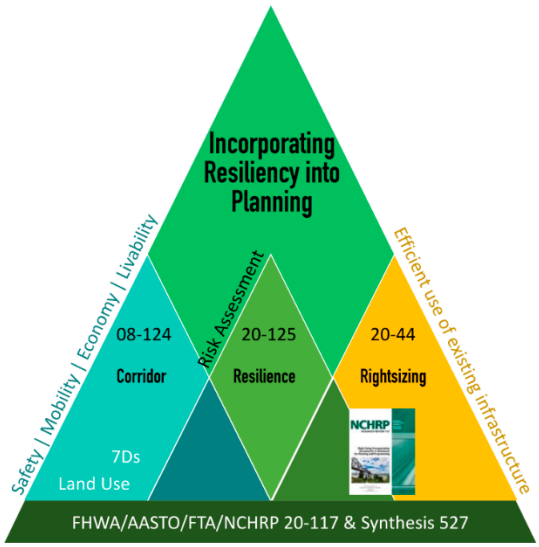
Business Case Defined – A business case describes *what* is a recommended course of action and then describes *why* it should be undertaken. The target audience for a business case is an *external* group of key stakeholders or decision makers. A business case will present the reasons for the recommended course of action in terms of:

1. Return on Investment (ROI)
2. Future Value (FV)
3. Net Present Value (NPV)
4. Present Value (PV)
5. Payback Period, Internal Rate of Return (IRR)
6. Sensitivity Analysis
7. Benefit/Cost Analysis (B/C)
8. Comparative Analysis

The business case is written by subject matter experts (not marketing experts) to convince a target audience (probably a non-technical group but may be mixed) of decision makers to adopt a resilience mindset. A business case provides support for undertaking and a rationale for the recommended solution.

Contrasted from a Business Plan – While a business case is *externally* directed and focuses on what and why, a business plan is *internally* directed and focuses on where, when, and how. The two may have common elements but are not interchangeable. The business case must incorporate careful target audience analysis to understand the motives and priorities of the external audience so that targeted messages can be developed and delivered through vectors the external audience finds credible.

Figure 5



Primary Obstacles to Application – Figure 5 on the right graphically represents

one of the major obstacles to the mainstreaming of resilience. The concept is just too big and overwhelming, and an already overstretched SDOT doesn't even know where to begin. Explaining how targeted integration of resilience into planning can support other political priorities such as critical corridor management and right-sizing of transportation investments.

Other obstacles include political or institutional inertia and apathy. These may take the form of:

- We're not a coastal state, and resilience only applies to things like hurricane evacuation.
- It's fiscally irresponsible to plan for the 500-year event. We don't have the resources for that.
- We don't have the money to maintain the roads we have, and you want us to build more?

Figure 6

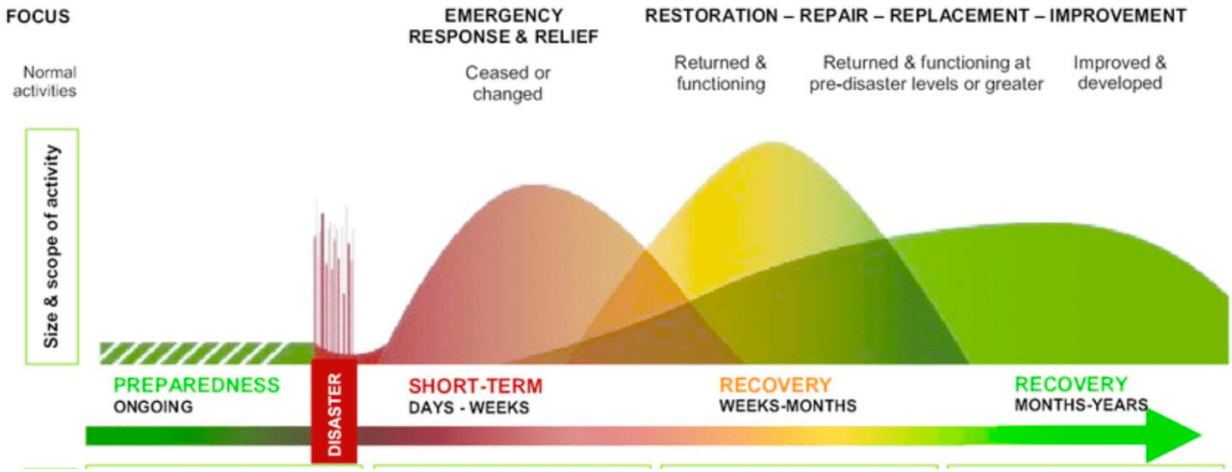


Figure 6 below is a depiction of the FEMA resilience cycle. At first glance it is easy to assume that we're talking about natural disasters, and that frames the entire resilience discussion. The business case broadens the discussion to include agile and adaptive responses to economic, public health, and political (social) unrest disasters (continuity of function). Resilience represents an *investment*. The responsibility for the costs of resiliency undertakings will be borne by the current decision-makers while the benefits will likely be realized by their successors. The question of "what's in it for me?" is a key component of the business case.

Third Stage: Mainstreaming the Resilience Program

The Five Case Model – Key stakeholder and decision groups that are the intended audiences of a given resilience business case will represent a variety of perspectives. To account for distinct points of view, each business case will need to address five distinct elements:

- The Strategic Case: That demonstrates how the recommended course of action aligns with the strategic and management objectives of the target audience.
- The Economic Case: That demonstrates the effectiveness of the recommended course of action in terms of future value, net-present value, and benefit/cost as described above.
- The Commercial Case: That demonstrates how the productions and attractions, and the linkages of compatible activities are available and resilient to support the target audience's objectives in adopting the recommended course of action. It may be necessary to describe the level of effort necessary to make the commercial linkages available and resilient.
- The Financial Case: This is related to the economic case and the commercial case in that it describes what the recommended course of action will cost to achieve in terms of ROI and IRR, as described above.
- The Management Case: That demonstrates how the recommended course of action will be integrated into existing statutory, regulatory, or policy frameworks. This assures the target audience that they do have the capacity to adopt the recommended course of action.

The target audience for the business case will probably lack a detailed knowledge of the subject matter. It is important to avoid jargon and keep the language as simple as possible. Use short sentences and break up the text with plenty of sub-headings. Paragraphs should be no more than four to five lines long and there should be a line between paragraphs. Shorter is better than longer, though it is important to try to instill a sense of urgency in the adoption of the recommended course of action.

The Costs of failure

It is difficult to argue against resilience and security in concept. One of the principal threats to such efforts, however, is the "going in" cost of such efforts. In order to make the business case for resilience and security, the risk tolerance of the client must be quantified. Then, the costs of failure can be measured against the going-in costs of the proposed actions. It is important to note that not all costs can be quantified in dollars. Loss of credibility and introduction (or reinforcement) of negative image of the SDOT on the part of elected/appointed officials or the public is a very real, if unquantifiable, cost.

The Cost of Failure – Resilience of Infrastructure

One of the most dramatic examples of the costs of lack of infrastructure resilience/security is observed in the aftermath of Hurricane Katrina and the levee

failures upon New Orleans. It was discovered, after the fact of course, that the infrastructure of the city (transportation, water, wastewater, power) could be radically disrupted. This left thousands of people stranded for an extended time. The damage to infrastructure can be quantified, the impacts to well-being and public image is qualitative rather than quantitative, but still significant.

The Cost of Failure – Continuity of Function

The economic lockdowns caused by the COVID-19 pandemic in 2020 forced many SDOTs into unfamiliar territory. Preservation of critical governmental function is challenged when the IT and security architecture is not in place for remote operations. Also, the lack of broadband capacity often delayed services, sometimes for weeks. While fiscal impacts may have been limited, the damage to image is significant.

A case study – the delaware dot resiience program (Stage 3 – Mainstreaming the resilience program)

In July 2017 the Delaware Department of Transportation (DelDOT) adopted the Strategic Implementation Plan for Climate Change, Sustainability & Resilience for Transportation (SIP). This SIP is the DelDOT's first attempt to develop a strategic and cohesive plan to promote a more resilient and sustainable transportation system in Delaware. The roots of this initiative are traced back to Executive Order 41 (EO41) that was issued by Governor Jack Markell in 2013. EO41, Preparing Delaware for Emerging Climate Impacts and Seizing Economic Opportunities for Reducing Emissions, directs Delaware agencies to address both the causes and consequences of climate change. A committee and working groups were established to address the goals of EO41 to reduce emissions that contribute to climate change, to increase resilience to climate impacts, and to avoid/minimize flood risks due to sea level rise. The Climate Framework for Delaware (December 31, 2014), a key report issued under E041, summarizes the 150 recommended actions that were assigned to agencies across the state, including 19 that were assigned to DelDOT. These recommendations are organized into four categories:

1. Incorporate Climate Change into Asset Management;
2. Ensure Workforce Public Health and Safety;
3. Support Climate Resilience in Local Communities; and
4. Identify and Support Policy Initiatives that reduce emissions.

The SIP documented the action items and performance measures for each of the recommendations, provides a strategy for completion of the recommendations that addresses key challenges and requirements, and looks beyond the climate framework recommendations to consider the broader context of resilience and sustainability.

Risk analysis is described as a particular challenge to this effort. Innumerable conversations with various internal and external stakeholders resulted in an ad-hoc determination that one year's DelDOT budget represented the acceptable level of self-insured risk to the program. A more structured and analytical approach to the question of acceptable resilience risk to a program is a significant research need and could possibly borrow heavily from the insurance industry. The acceptable level of risk is a question of primary importance, as it guides the required investment levels during the program development stage.

One of the most important take-aways of the DelDOT implementation effort is the scope and breadth of the implementation effort. While a resilience program may be "housed" within a particular office, full implementation is clearly an enterprise-wide undertaking that in the DelDOT application included:

- Office of the Secretary
- Planning
- Maintenance & Operations (M&O)
- Finance
- Delaware Transit Corporation (DTC)
- Transportation Solutions, including the Transportation Management Center (TMC)
- Technology and Innovation

Integration of the SIP into various policy frameworks is the critical step necessary to mainstream resilience and security into the way DelDOT conducts itself. Resilience and security becomes a way of thinking.

Finally, the SIP document also includes outreach and training to political subdivisions of the State and there is an entire section in the plan document on inclusion of local entities. There is also a section on monitoring and reporting of the performance measures identified during the program design phase. This provides DelDOT the opportunity to prove and celebrate successes and defend resource allocations. Potential resources at federal and state levels are also included.

Conclusion

Resilience and security can be difficult to define and can mean many things to many people, but a clear business case for resilience and security is lacking. Such is very easy to discuss but very difficult to effectively implement. The process for development of a business case for resilience in infrastructure and continuity of critical function has three stages:

- Stage 1 – Definition of Resilience and Identification of Measures

- Stage 2 – Risk Analysis and Program Development
- Stage 3 – Mainstreaming the Resilience Program, which includes the marketing of the program, creation of intergovernmental and public/private partnerships, and integration of the program into existing policy frameworks.

The costs of failure are steep and go well beyond responses to natural disasters. Resilience of infrastructure and continuity of critical function are the two primary areas that should be of concern to SDOTs. The DelDOT implementation effort demonstrates that resilience is an enterprise-wide undertaking and must become a way of thinking rather than a specific program.

Author contribution statement

The authors confirm contribution to the paper as follows: study conception and design: data collection: analysis and visualization of results, and manuscript preparation. All authors reviewed the results and approved the final version of the manuscript. This is an original paper. This paper is enhanced and updated from an earlier manuscript the authors submitted and got approved for a poster presentation at the 2022 Transportation Research Board of the National Academies of Sciences, Medicine, and Engineering.

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