Università Ca'Foscari Venezia

Sustainable and Resilient Solutions for Cruise Tourism: Methodology and Examples

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Challenge

- **many "solutions** in a POST-COVID world in a context of reconfiguration of power relations between cruise corporations and destinations"
- "**stakeholders** now have the knowledge and experience with the cruise tourism industry's operating modes."
- "How to regain a more **environmental friendly and cultural sustainable** cruise tourism, with additional added value for local economies in the region?"

From Prof. Renaud presentation

Summary

- **Resilience** "to adapt to the situation and readjust its activities following COVID-19 pandemic"
- **MCDA** "to develop a better understanding of which policies and local practices can enhance the economic benefits of hosting port-cities without having a negative impact on its environmental and cultural heritage."

Science of the Total Environment 642 (2018) 668–678

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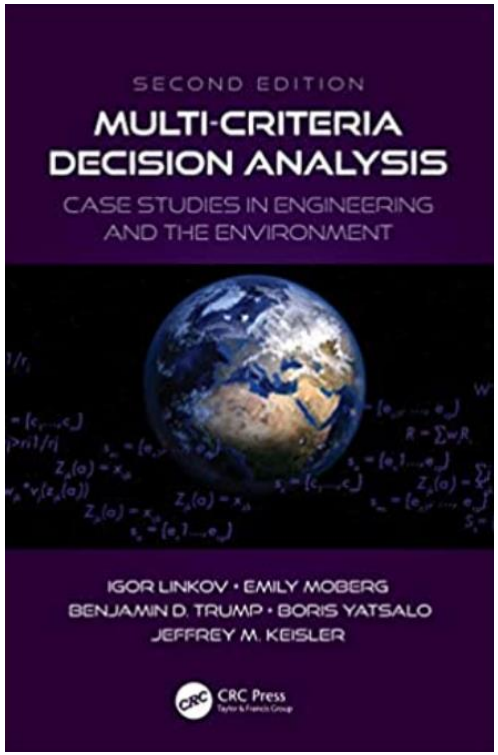
Selecting sustainable alternatives for cruise ships in Venice using multi-criteria decision analysis

Marco Pesce [a], Stefano Terzi [a,b], Raid Issa Mahmoud Al-Jawasreh [a], Claudia Bommarito [a], Loris Calgaro [a], Stefano Fogarin [a], Elisabetta Russo [a], Antonio Marcomini [a], Igor Linkov [a,c,d,*]



Multi Criteria Decision Analysis

Decision-Maker(s)

Decision Analytical Frameworks
- Agency-relevant/Stakeholder-selected
- Currently available software
- Variety of structuring techniques
- Iteration/reflection encouraged
- Identify areas for discussion/compromise

Environment | *Economic* | Social | Stakeholders Opinion

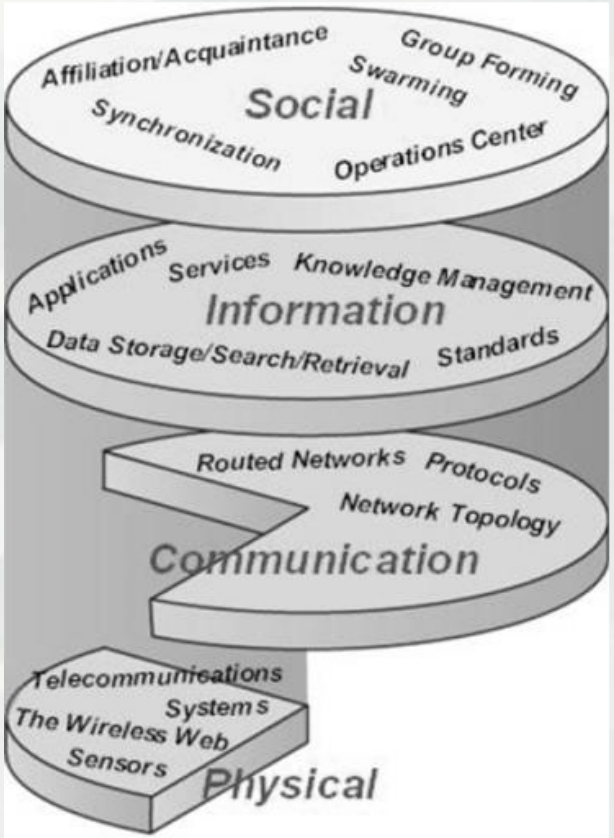
Sharing Data,Concepts and Opinions

Decision Integration

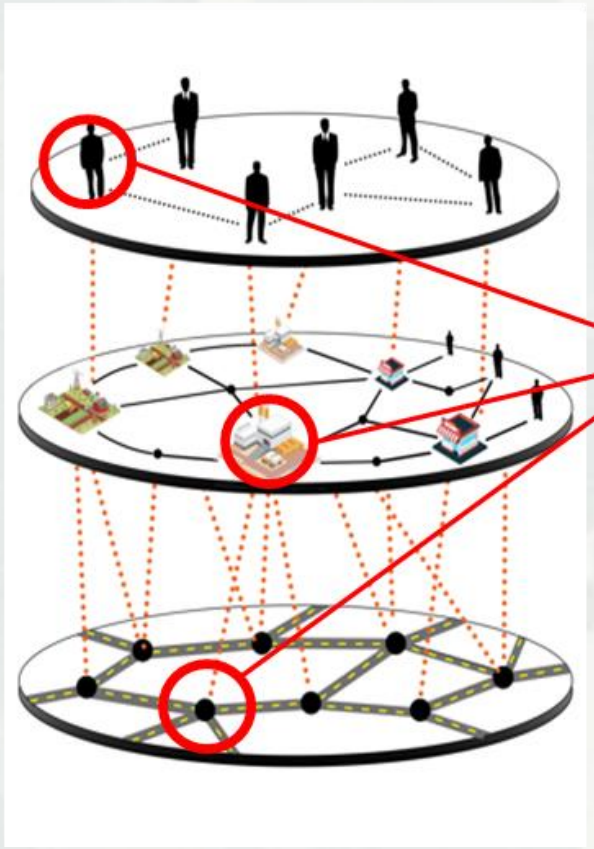
Tool Integration

Vision for Resilience Analytics Related to Cruise Tourism

Real World



Model



Operations

Management Alternatives

Nine Terms for Systems Withstanding Threats

- Adaptability
- Agility
- Reliability
- Resilience
- Resistance
- Robustness
- Safety
- Security
- Sustainability

Results of Semi-Structured Interviews

	Threat Type		System Response			
	Acute	Chronic	Focused	Broad	External	Internal
Adaptability		X		X		X
Agility	X		X			X
Reliability		X	X			X
Resilience	X			X		
Resistance	X		X		X	
Robustness	X		X		X	
Safety		X	X		X	
Security		X	X		X	
Sustainability		X			X	

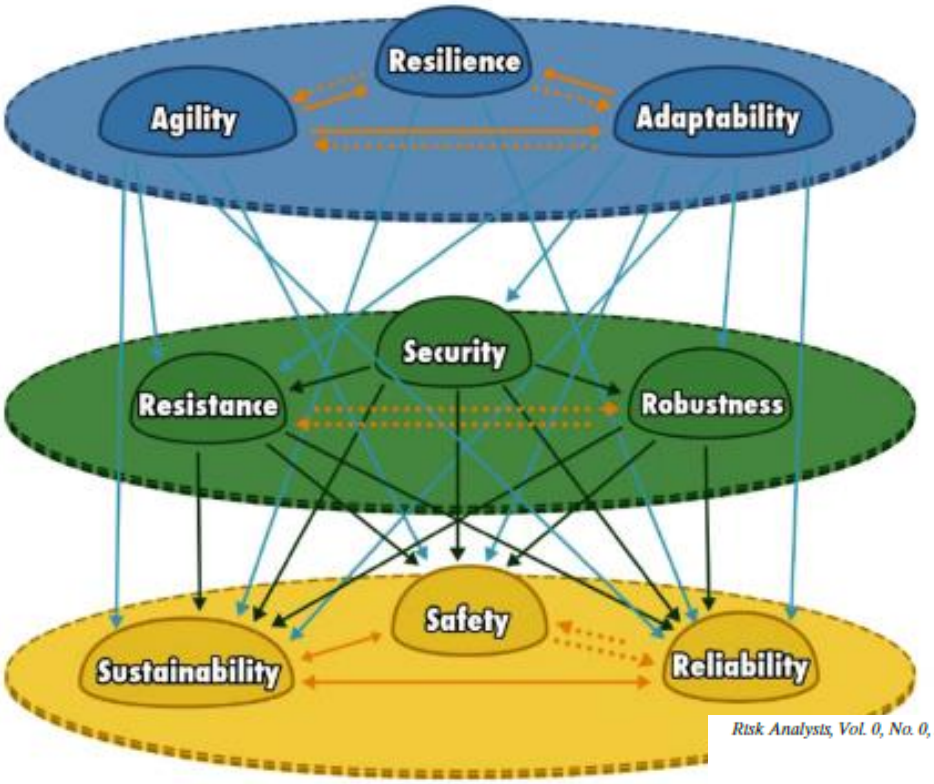
Green: most characteristic of dichotomy
Red: least characteristic of dichotomy
Yellow: dichotomy aspects equally weighted

Risk Analysis, Vol. 0, No. 0, 2020 DOI: 10.1111/risa.13577

The Need to Reconcile Concepts that Characterize Systems Facing Threats

S. E. Galaitsi,[1] Jeffrey M. Keisler,[2] Benjamin D. Trump,[1] and Igor Linkov[1,*]

System Affected by Threats: Taxonomy



The deliberate actions or choices taken

The short term consequences or abilities enabled by those actions

The long-term outcomes enabled by actions and abilities

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The Need to Reconcile Concepts that Characterize Systems Facing Threats

S. E. Galaitsi,[1] Jeffrey M. Keisler,[2] Benjamin D. Trump,[1] and Igor Linkov[1,*]

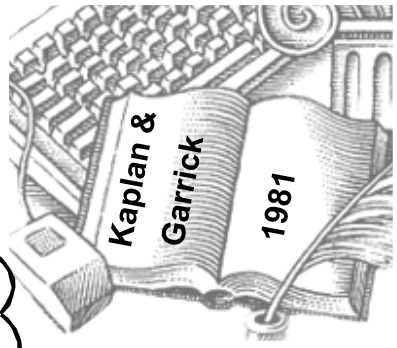
Risk Assessment Formulation

Threat

What can happen (go wrong)?

Vulnerability

How likely is it?



Consequences

What are the consequences?

Risk ~ Threat*Vulnerability*Consequences

Risk -- “a situation involving exposure to danger [threat].”

Security -- “the state of being free from danger or threat.”

Resilience -- “the capacity to recover quickly from difficulties.”

Definitions by Oxford Dictionary

30 | NATURE | VOL 555 | 1 MARCH 2018

Don’t conflate risk and resilience

‘Risk’ and ‘resilience’ are fundamentally different concepts that are often conflated. Yet maintaining the distinction is a policy necessity. Applying a risk-based approach to a problem that requires a resilience-based solution, or vice versa, can lead to investment in systems that do not produce the changes that

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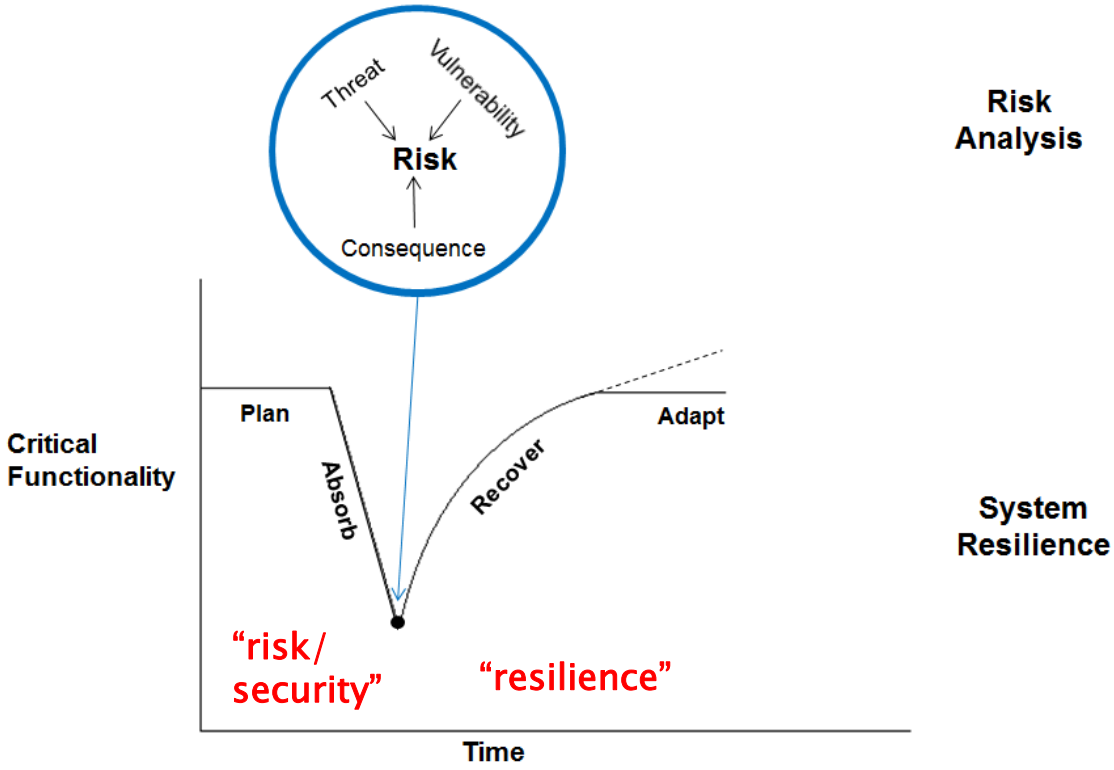
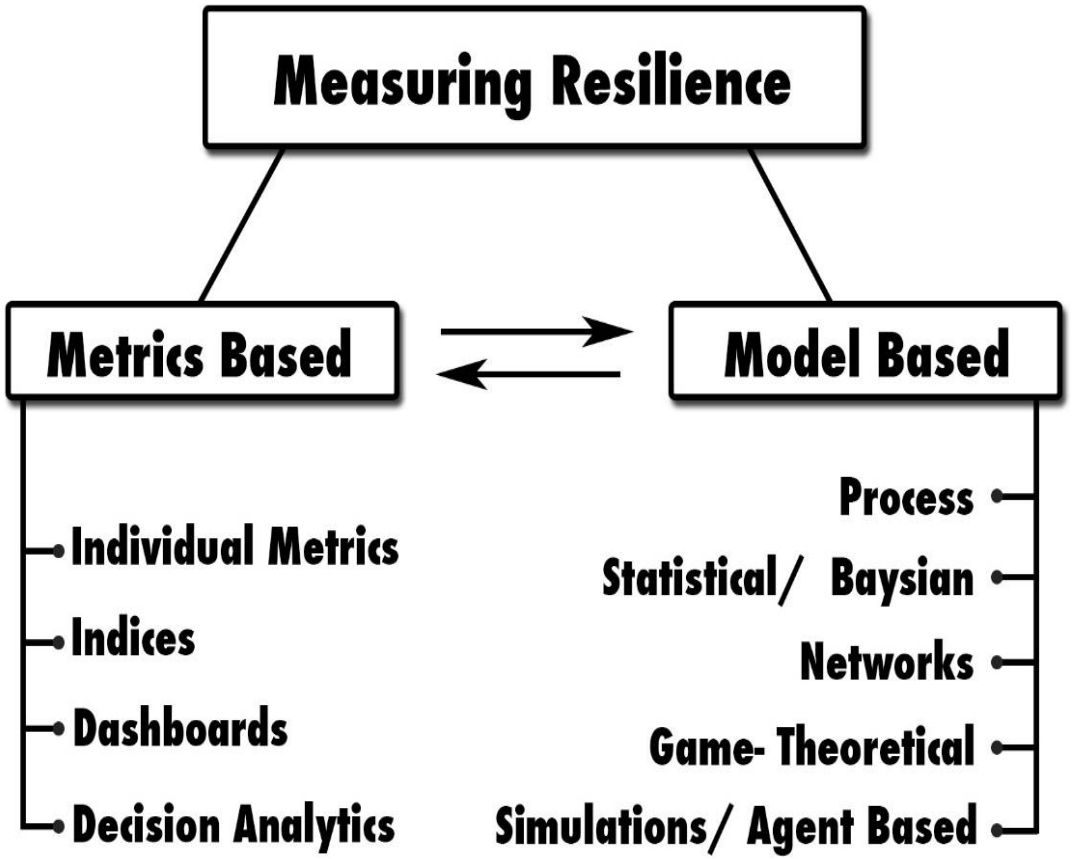
System Risk/Security and Resilience

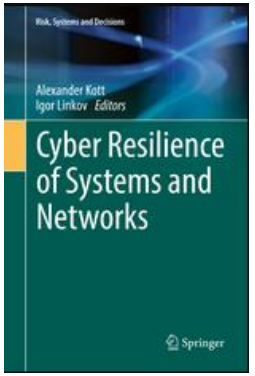


After Linkov et al, Nature Climate Change 2014

How to Measure Resilience, Sustainability, Risk?



After 2019



Cruise ship tourism in Venice

Venice has been a port city for more than a millennium

History

Culture

Environment

Generate a virtually unlimited demand of tourism

Cruise ship business offers important economic opportunities for both the city of Venice and the cruise lines

Venice, as **leading Mediterranean Home port**:

- 1.5 to 2 million tourists per year
- Positive local impact (hotels, transports, shops)
- Other activities (refueling, change of passengers)
- Positive impacts on other Mediterranean ports

la Nuova di Venezia e Mestre 9 Novembre 2015

VENEZIA

Grandi navi, Zanda: "Valutare tutte le soluzioni"

Luigi Zanda, leader of the Democratic Party at the Senate, “We have to take a decision quickly, but we have to do it well. We have to evaluate the consequences of interventions and excavations that could affect the balance of the lagoon”.

Il Sole 24 ORE IMPRESA & TERRITORI 9 Dicembre 2014

Grandi navi a Venezia, associazioni in campo per una soluzione

Call of the workers’ associations to the government “We need to find a rapid solution in order to reconcile an important economic activity such as the cruise ship industry with the preservation of the city."

CORRIERE DEL VENETO

Veneto / Cronaca

7 Novembre 2016

Delrio: «Basta grandi navi alla Marittima Il ministero studia l'ipotesi Marghera

Brugnaro: «Avremo modo di chiarirci. Il Vittorio Emanuele va sistemato in ogni caso»

Repartee between the **Minister of Infrastructure and Transport** Graziano del Rio, and the **Mayor of Venice** Luigi Brugnaro.

Today the Minister said «No to large cruise ships at Marittima». Immediate the response of the Mayor «I will require further clarification. The game is not over»

Cruise ship tourism in Venice

Environmental and social burdens limit the cruise ship business in Venice. The current situation seems unsustainable.

R.it

Venezia, stop al transito delle grandi navi dal primo novembre 2014

ANSA.it

Da Unesco alert a Venezia su Grandi Navi

Italia Nostra, ora governo intervenga

Il Sole 24 ORE

Ecco come togliere le grandi navi da San Marco: due progetti in competizione

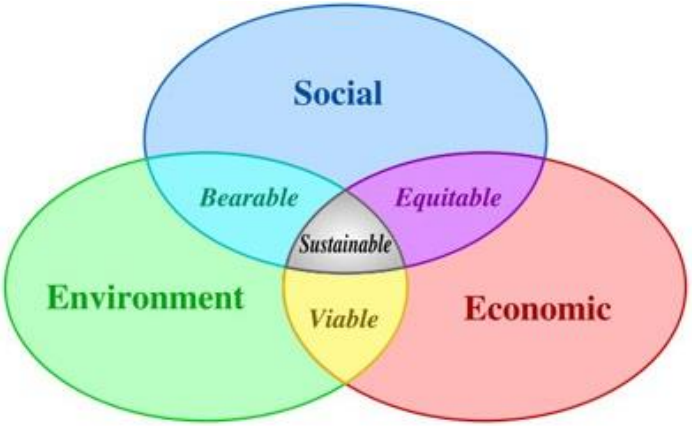
- New viable alternatives are under evaluation
- Controversies (economic benefits, environmental impacts, social discontent)
- Situation of high uncertainty and significant variability
- Evaluation of tradeoff is difficult

The process is stalled at political level

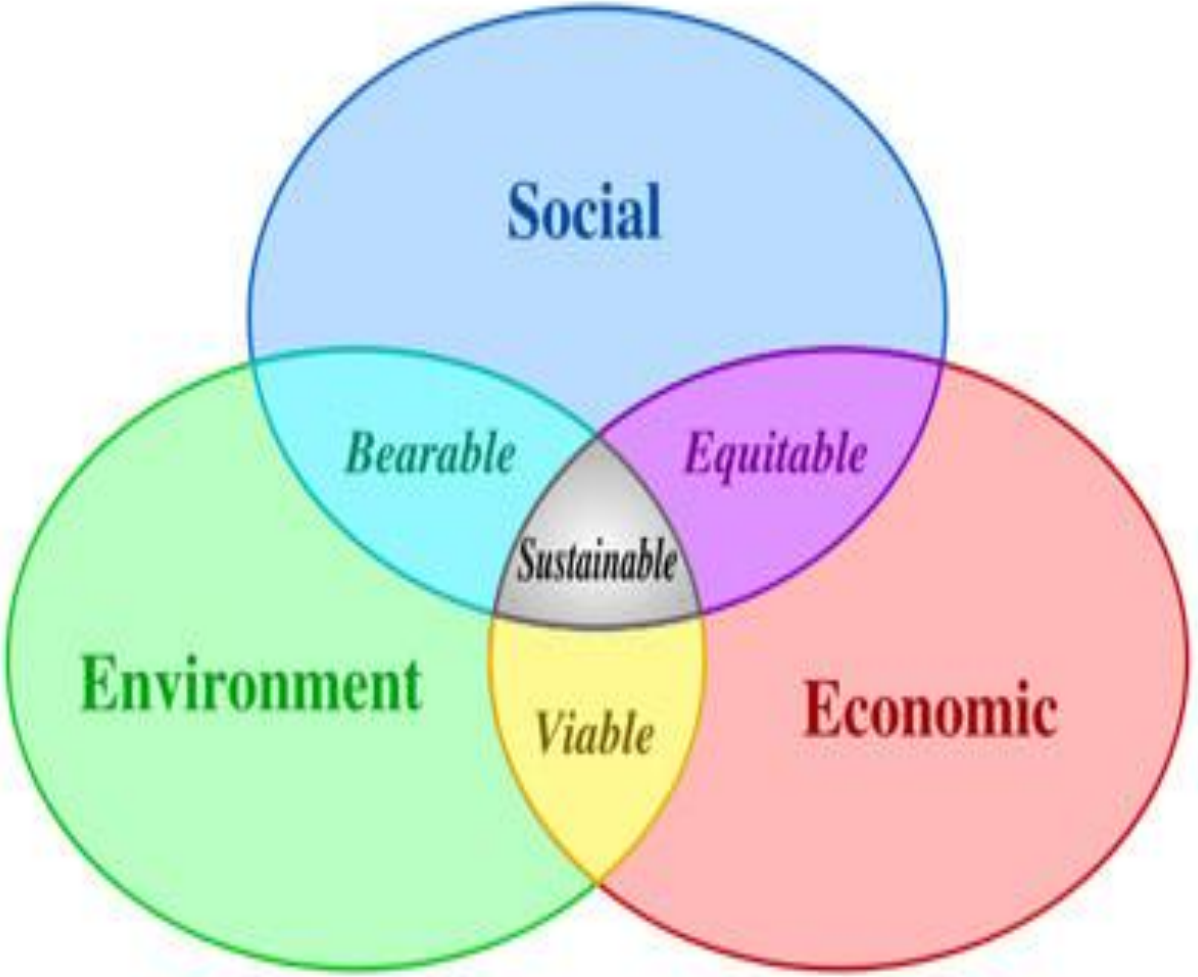
Cruise ship tourism in Venice

The use of **MCDA techniques** can help solving a complex and controversial problem, such as cruise ships in Venice

- Integrate qualitative and quantitave information from different sources
- Frame the problem of cruise ships in Venice within the context of sustainability
- Evaluate tradeoffs between the identified multiple criteria



How Science Can Help: Sustainability as Triple Bottom Line



Source: landlogics.net

What does Sustainability mean?

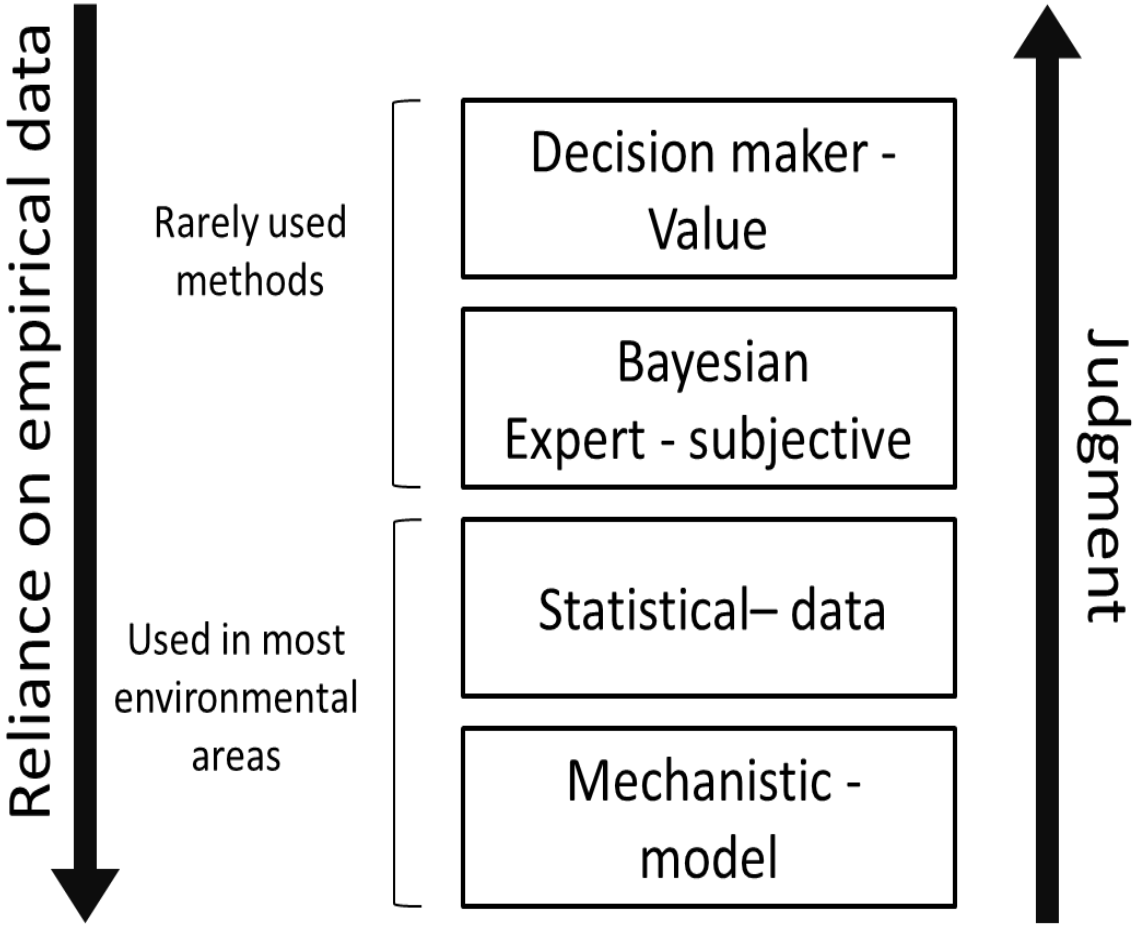
- **World Commission on Environment and Development (Brundtland Commission), 1987**

"Development which meets the needs of current generations without compromising the ability of future generations to meet their own needs."

- **President Obama's Executive order 13514 of October 5, 2009**

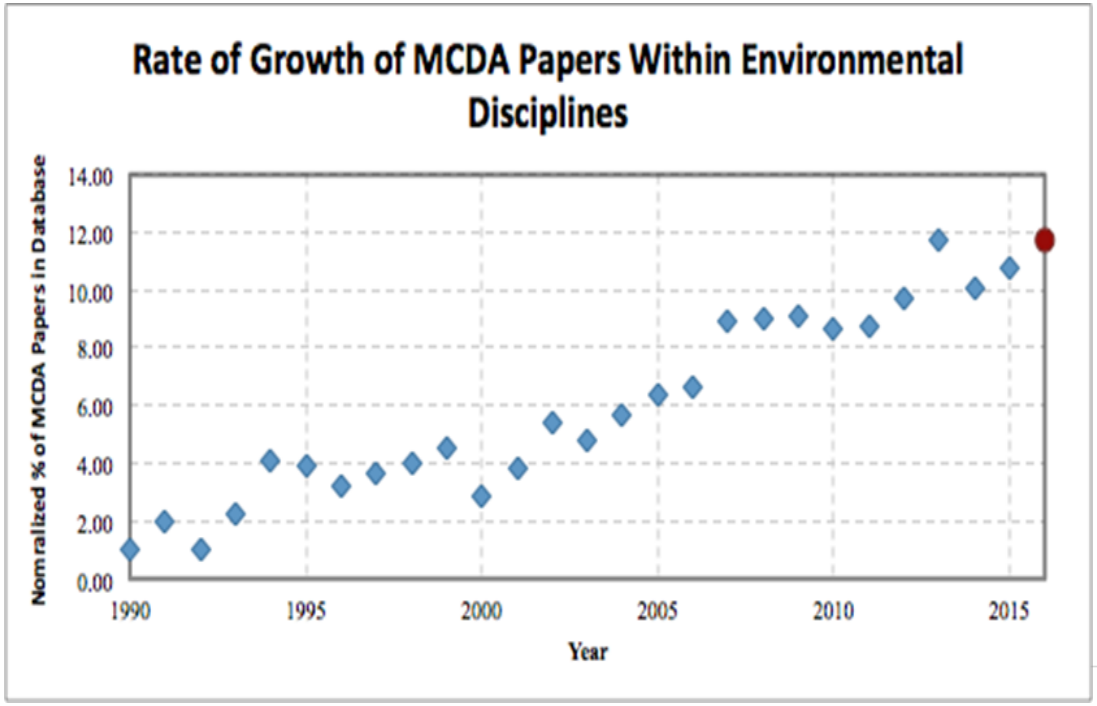
"Sustainability" and "sustainable" mean to create and maintain conditions, under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic, and other requirements of present and future generations."

How can Sustainability be Quantified?

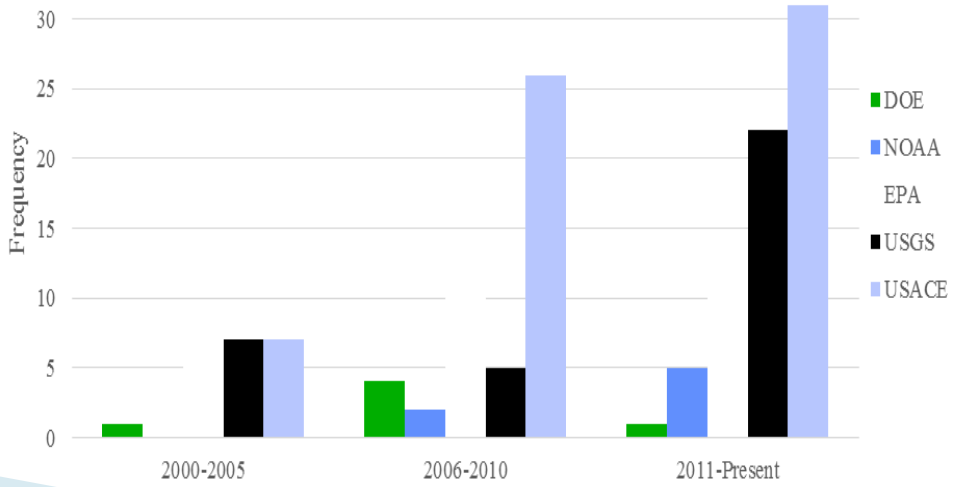


Keisler, Linkov (2014)

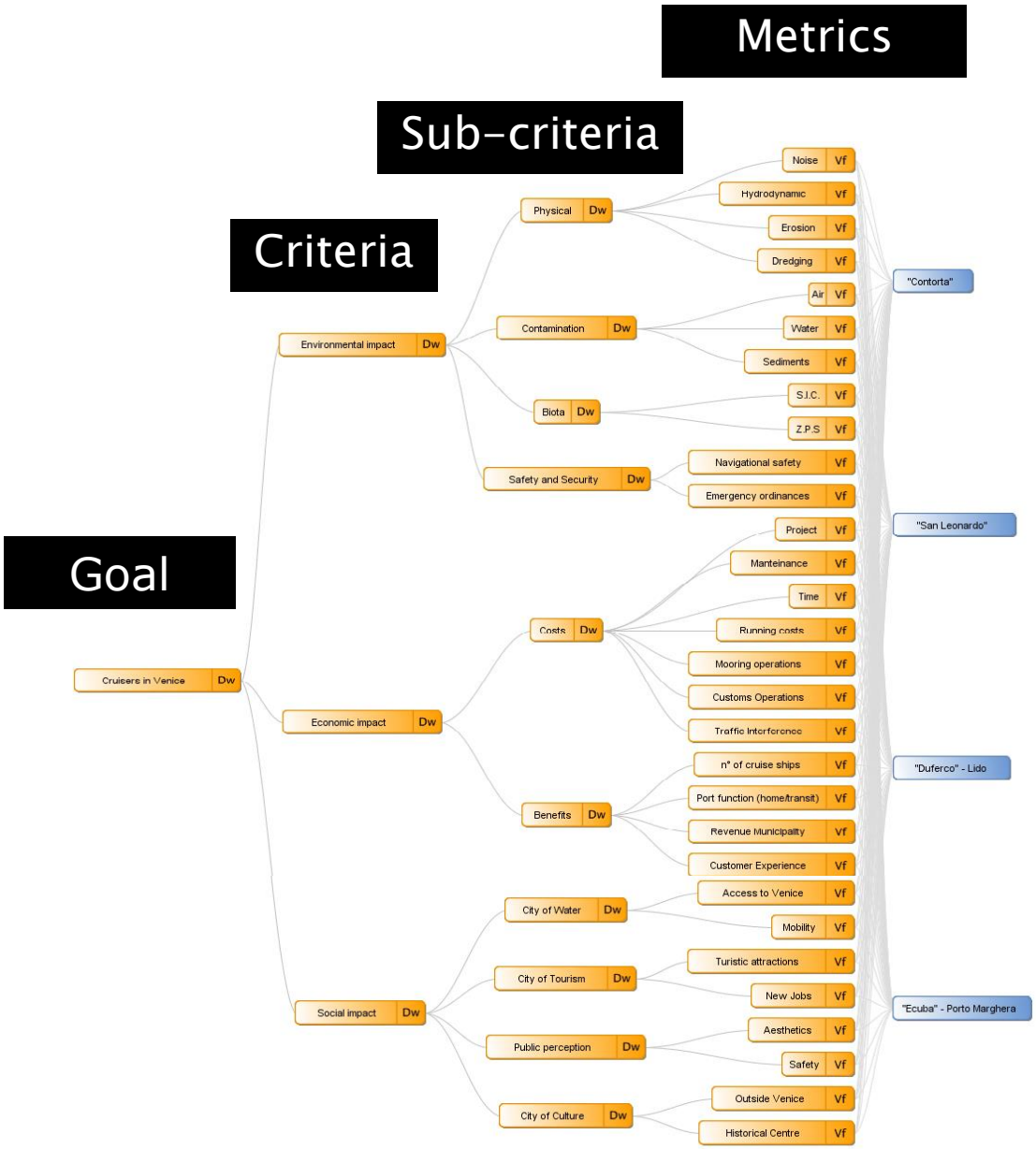
Why Decision Analysis?



MCDA use in Government



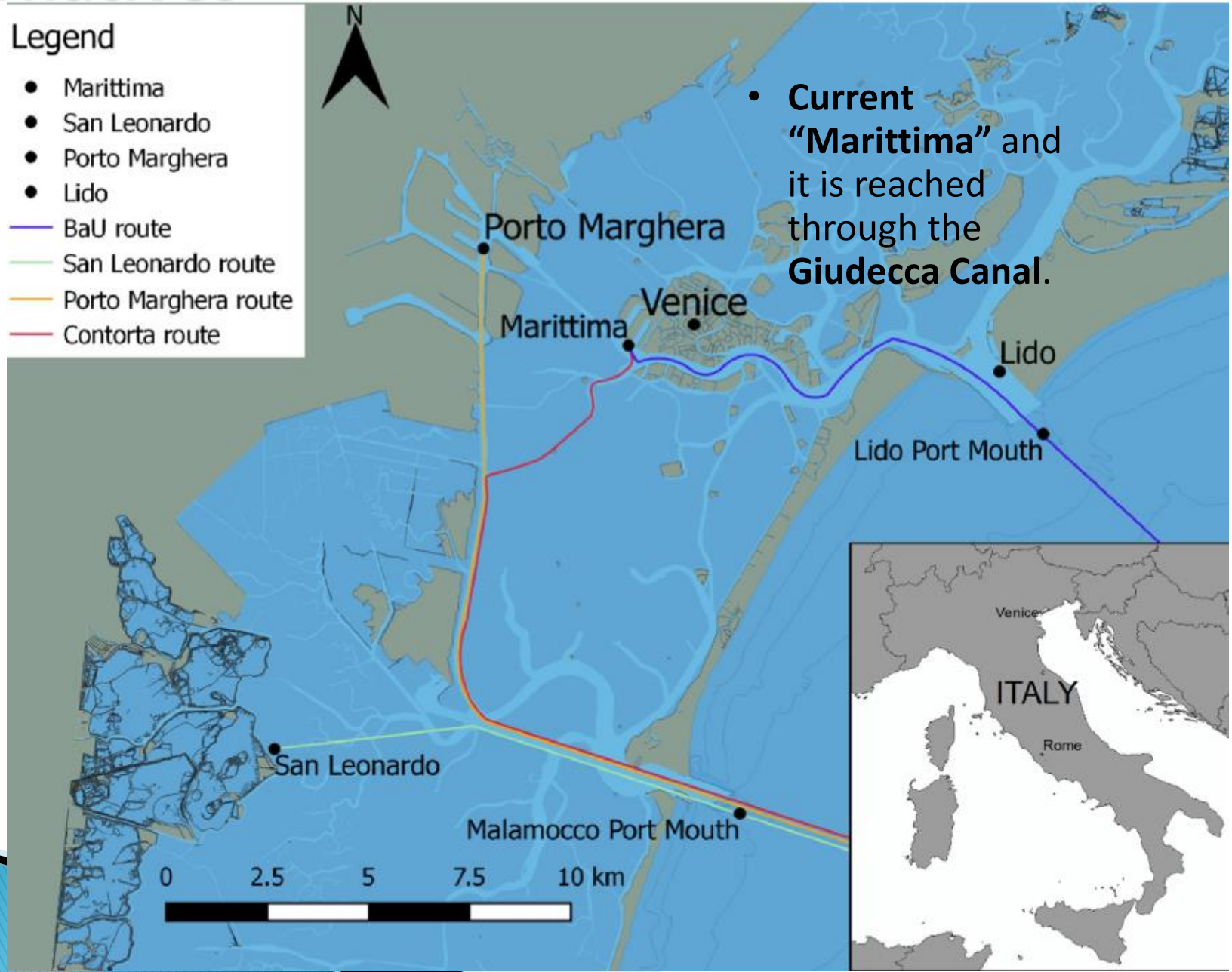
MCDA Model Structure and Criteria



Weights

Each stakeholder assigns their own weights to each criterion, sub-criterion, metric

Alternatives

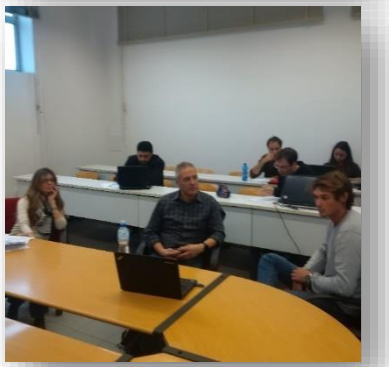


- **Current "Marittima"** and it is reached through the **Giudecca Canal**.

Approach to Alternative Scoring

- Review of Relevant Literature and Report:
  - EIA reports of the selected projects
  - Environmental studies on cruise ships
  - Economic reports (e.g. «Impatto Economico della crocieristica a Venezia»)
  - Venice Strategic Plan

- Expert Interviews
  - Stefano Soriani (Ca' Foscari University)
  - Stefano Della Sala (VERITAS S.p.A.)
  - Francesco Pedrini (A4smart Srls)
  - Alessandro Santi (S.M.C. Srl)
  - Erika Faresin (S.M.C. Srl)
  - Luca Zaggia (CNR)
  - Gianmarco Scarpa (CNR)
  - Cesare De Piccoli (Promoter Duferco project)



SOCIAL IMPACT

CITY OF CULTURE

- Promoting the existing resources through an efficient and innovative management.
- Preserving Venice historical center's cultural patrimony.

CITY OF WATER

- Recognizing the added value given by water presence in the territory to the economic and productive sector.
- Optimizing the access to the historical centre of Venice without interfering with public transportation.

CITY OF TOURISM

- ✓Tourist system management acting on fluxes and improving the offers quality.
- ✓Creation of new job opportunities

PUBLIC PERCEPTION

- Stakeholders engagement on risk perception and aesthetic impact.

SOCIAL SUSTAINABILITY

Alternatives scoring

		"Contorta"	"San Leonardo"	"Duferco" - Lido	"Ecuba" - Porto Marghera
City of Water	Access to Venice	1.000	0.000	0.467	0.800
	Mobility	1.000	1.000	0 .000	1.000
City of Tourism	Turistic attractions	0.333	0.000	1.000	0.667
	New Jobs	0.000	1.000	0.556	1.000
City of Culture	Outside Venice	0.333	0.500	0.000	1.000
	Historical Centre	0.000	1.000	0.700	0.500
Public perception	Aesthetics	0.000	1.000	0.667	0.333
	Safety	0.000	0.667	1.000	0.333

CURRENT ECONOMIC SITUATION OF THE PORT OF VENICE AT "MARITTIMA"

Venice is the first **Home Port** for cruiseships in the Mediterrean

More than 80 % of passengers arrive with cruiseship using the port as ***boarding*** and ***landing*** terminal → more benefits for the city

Over **500** cruiseships and more than **2 Millions** of passengers per year

About **7.000** national jobs and **4.000** local jobs

Local incoming of about **300 Millions** of Euros per year

THE IMPORTANCE OF BIG SHIPS

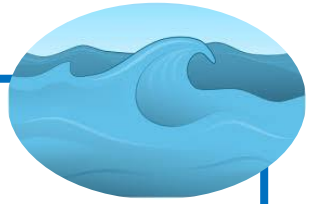
(over 40.000 tons)

2012

94 % of passengers

High percentage of passengers using this kind of ships

ENVIRONMENTAL IMPACT



Physical issues

- *Hydrodynamic* → **i)** waves' problems in Giudecca Canal and San Marco basin
- *Erosion* → in saltmarshes and mudflats, near Fusina shore
- *Noise* → noise of the engines and the cruise-tourism activity
- *Dredging* → sediment'mobility due to canal'building

Contamination

- *Air pollution* → troubles for ships transit in Giudecca Canal and nearby areas
- *Water pollution* → risks of chemical pollutants spill over near docks and along the way
- *Sediment pollution* → **i)** pollutants re-mobilization due to dredging /transit **ii)**spill over of adsorbing pollutants

Safety and security

The constant monitoring of port 'sensitive areas, the internal navigation channels and the road and railway access points

Biota

- **Sic**→ "Site of Community Importance" involvement
- **Zps** → "Zona di Protezione Speciale" involvement

Stakeholder profiles

Environmental groups

Advocate the sustainable management of Venice. Centered on ecology, health, society


10 %


20 %


70 %

Municipality

Interest in finding a balance between economy, society, and environment


10%


70%


20%

Cruise ship companies

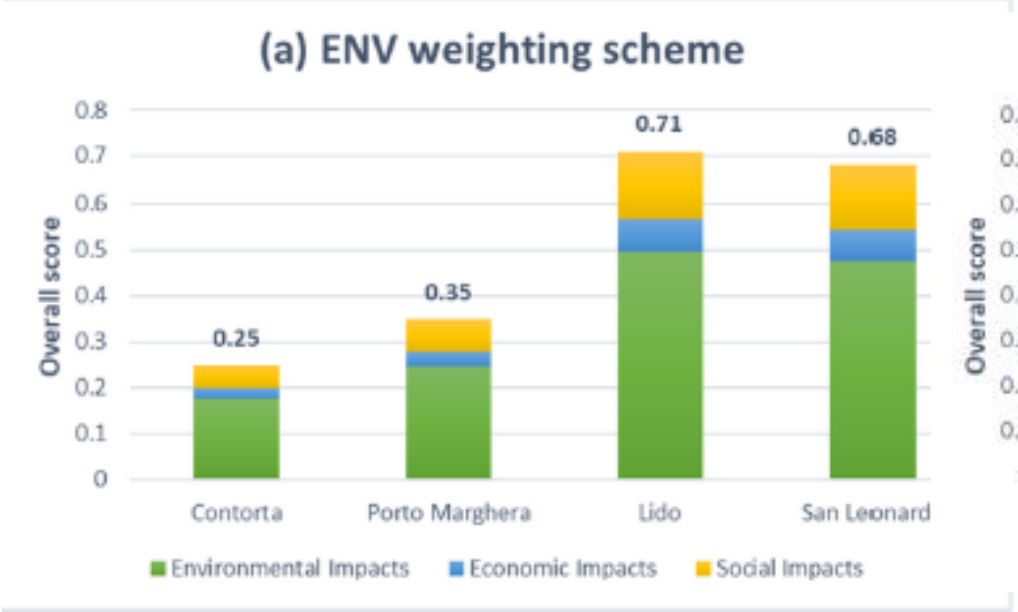
Act in order to maximise the profit of the company

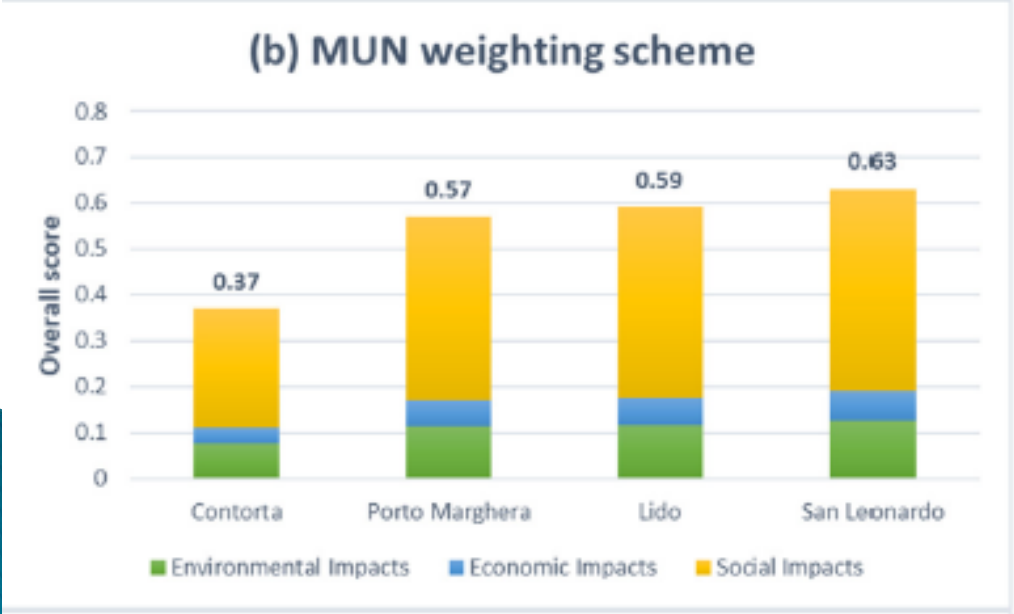

70 %

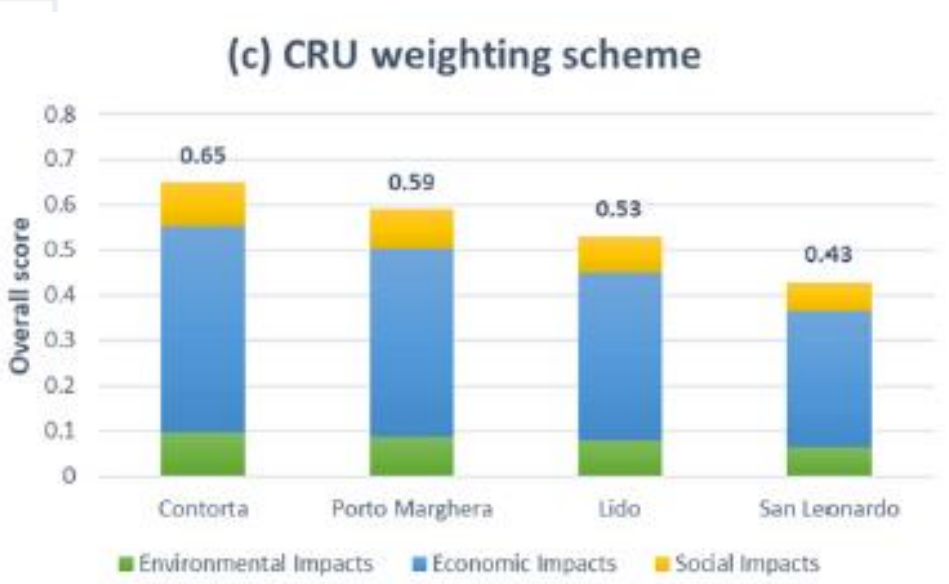

15 %


15 %

Overall scores for alternatives



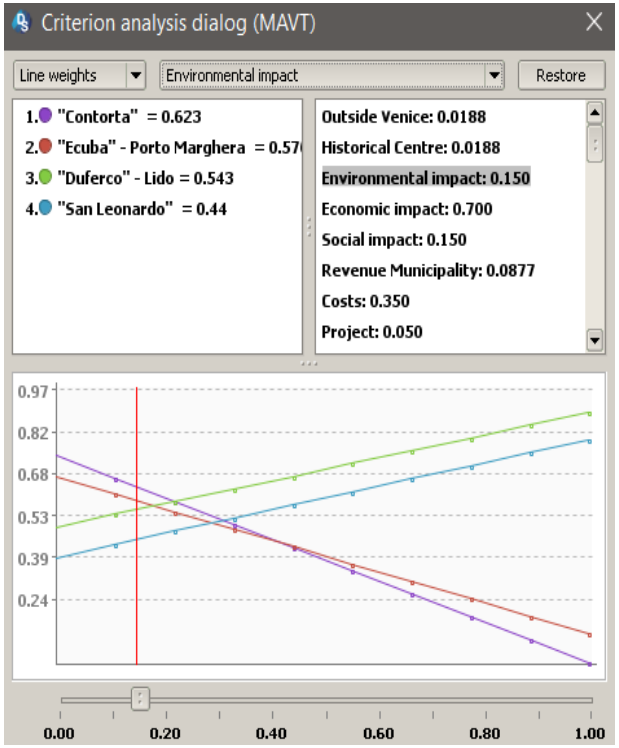


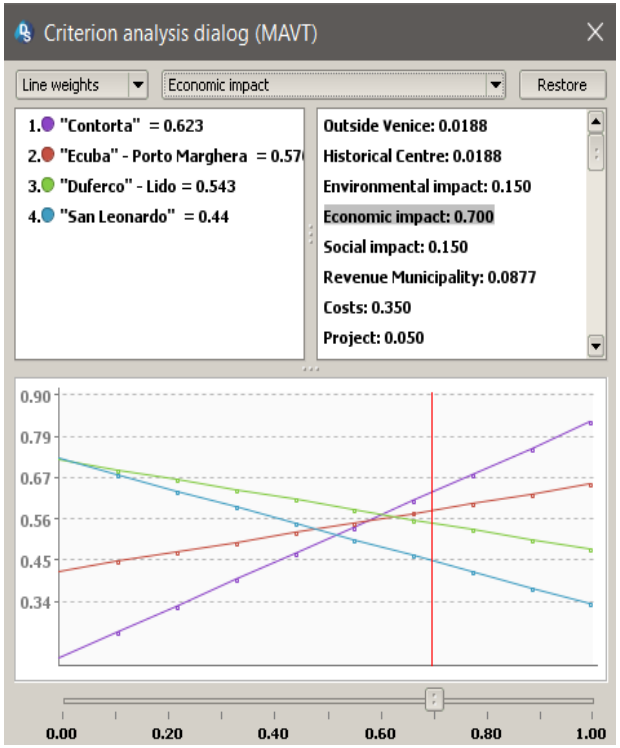


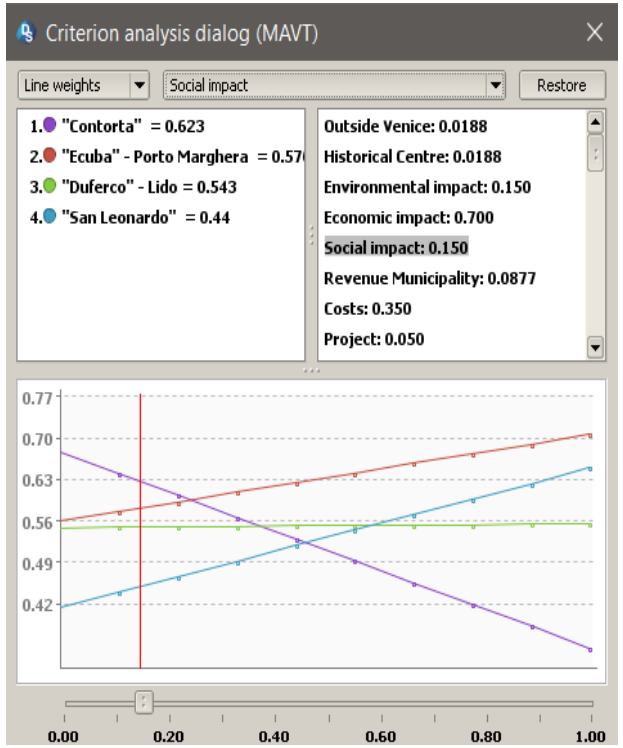
Lido and San Leonard are top 2 For Environmentalists and Municipalities, while Cruise Operators prefer Contorta

Sensitivity Analysis

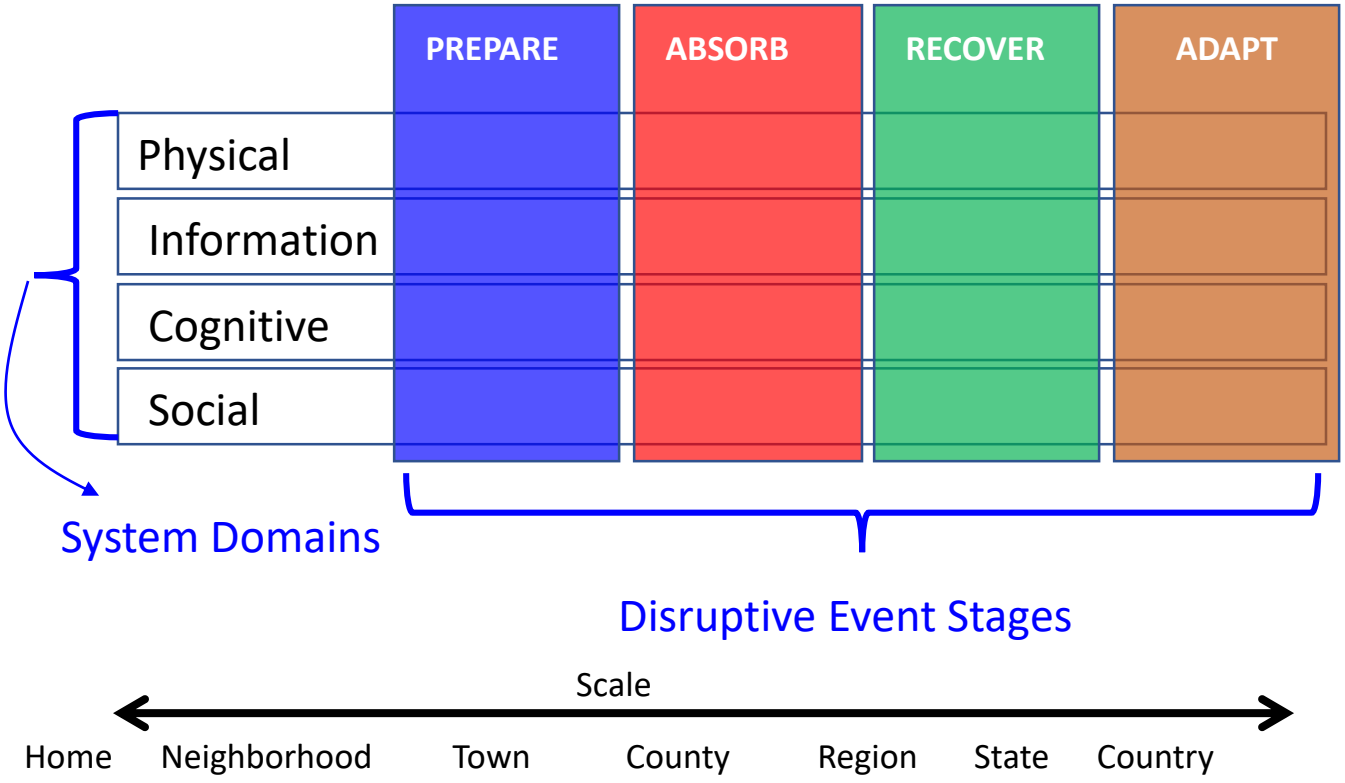
Cruise ship companies







Resilience Matrix



Assessment using Decision Maker Values

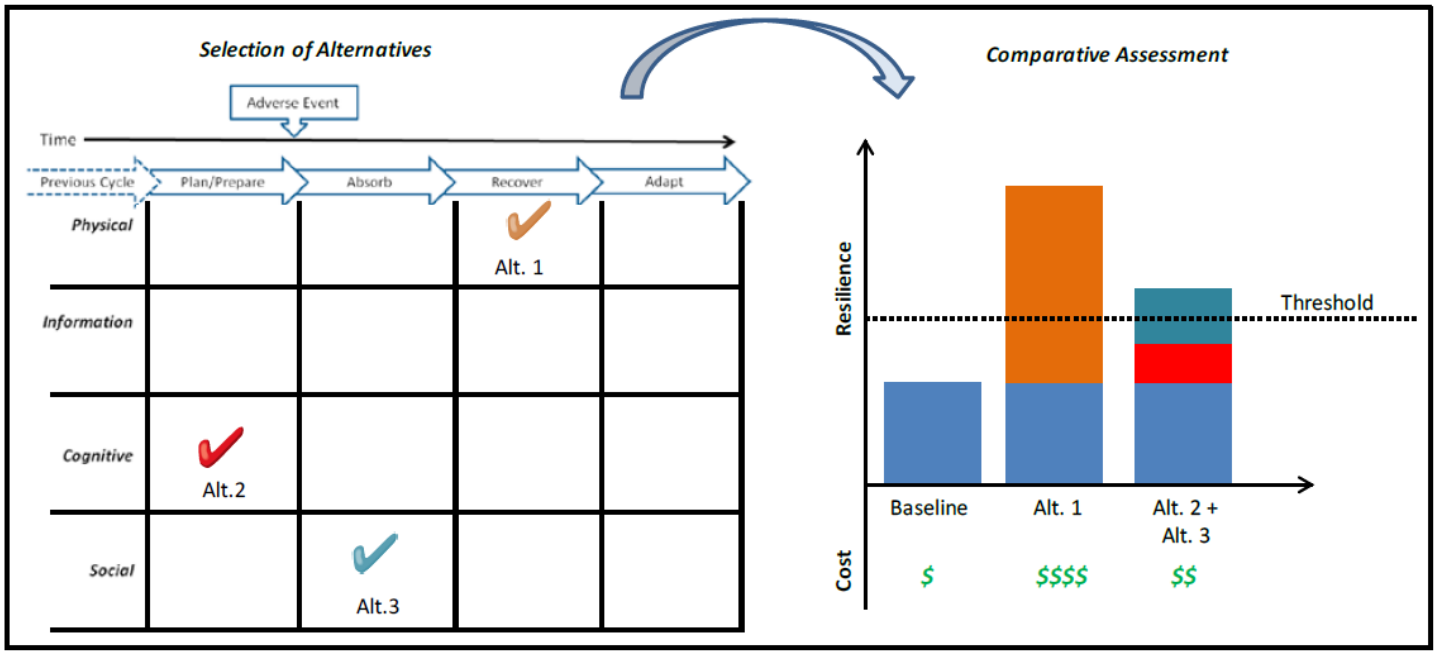


Figure 5: Comparative Assessment of Resilience-Enhancing Alternatives

Use developed resilience metrics to comparatively assess the costs and benefits of different courses of action

Alternative Evaluation

- Baseline assessment can be used to evaluate proposed alternative

	Prepare	Absorb	Recover	Adapt
Physical	71	16	60	10
Information	63	45	21	18
Cognitive	90	49	38	27
Social	82	54	12	52

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Project 1

	Prepare	Absorb	Recover	Adapt
Physical	+10	+18	+9	+32
Information	+8		+17	
Cognitive				
Social				

	Prepare	Absorb	Recover	Adapt
Physical	81	34	69	42
Information	71	45	38	18
Cognitive	90	49	38	27
Social	82	54	12	52

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Project 2

	Prepare	Absorb	Recover	Adapt
Physical				
Information		+5	+15	+22
Cognitive				
Social	+3		+12	+21

	Prepare	Absorb	Recover	Adapt
Physical	71	6	60	10
Information	63	50	36	40
Cognitive	90	49	38	27
Social	85	54	24	73

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*ALternativess may have (+) or (-) in other matrices

Network-based Resilience Theory?

System's *critical functionality* (*K*)

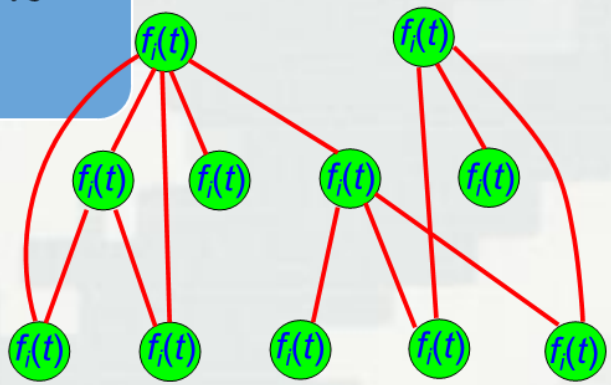
Network topology: *nodes* ($\mathcal{N}$) and *links* ($\mathcal{L}$)

Network *adaptive algorithms* ($\mathcal{C}$) defining how nodes' (links') properties and parameters change with time

A *set of possible damages* stakeholders want the network to be resilient against ($\boldsymbol{E}$)

$$R = f(\mathcal{N}, \mathcal{L}, \mathcal{C}, \boldsymbol{E})$$

Ganin et al., 2016

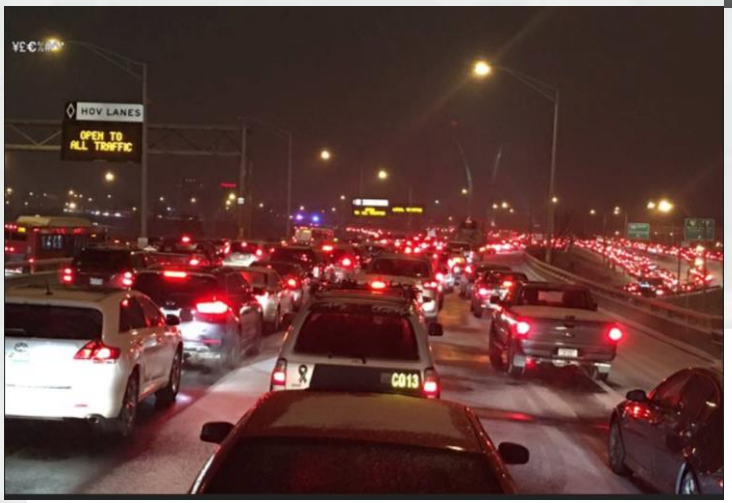


Resilience: Case Study in Transportation

Poor Efficiency:

System cannot not accommodate a large volume of commuters driving at the same time.

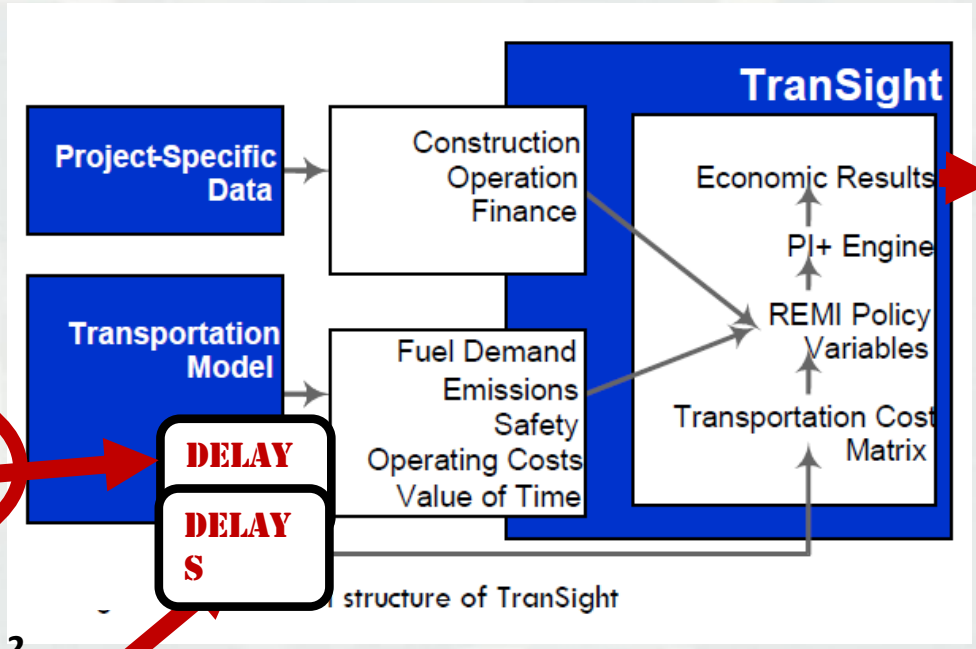
Traffic congestions are predictable and are typically of moderate level.



Lack of Resilience:

System cannot recover from adverse events
(car accidents, natural disasters)

Traffic disruptions are not predictable and of variable scale.



Scenario 1
"Baseline"

Random Network Disruptions

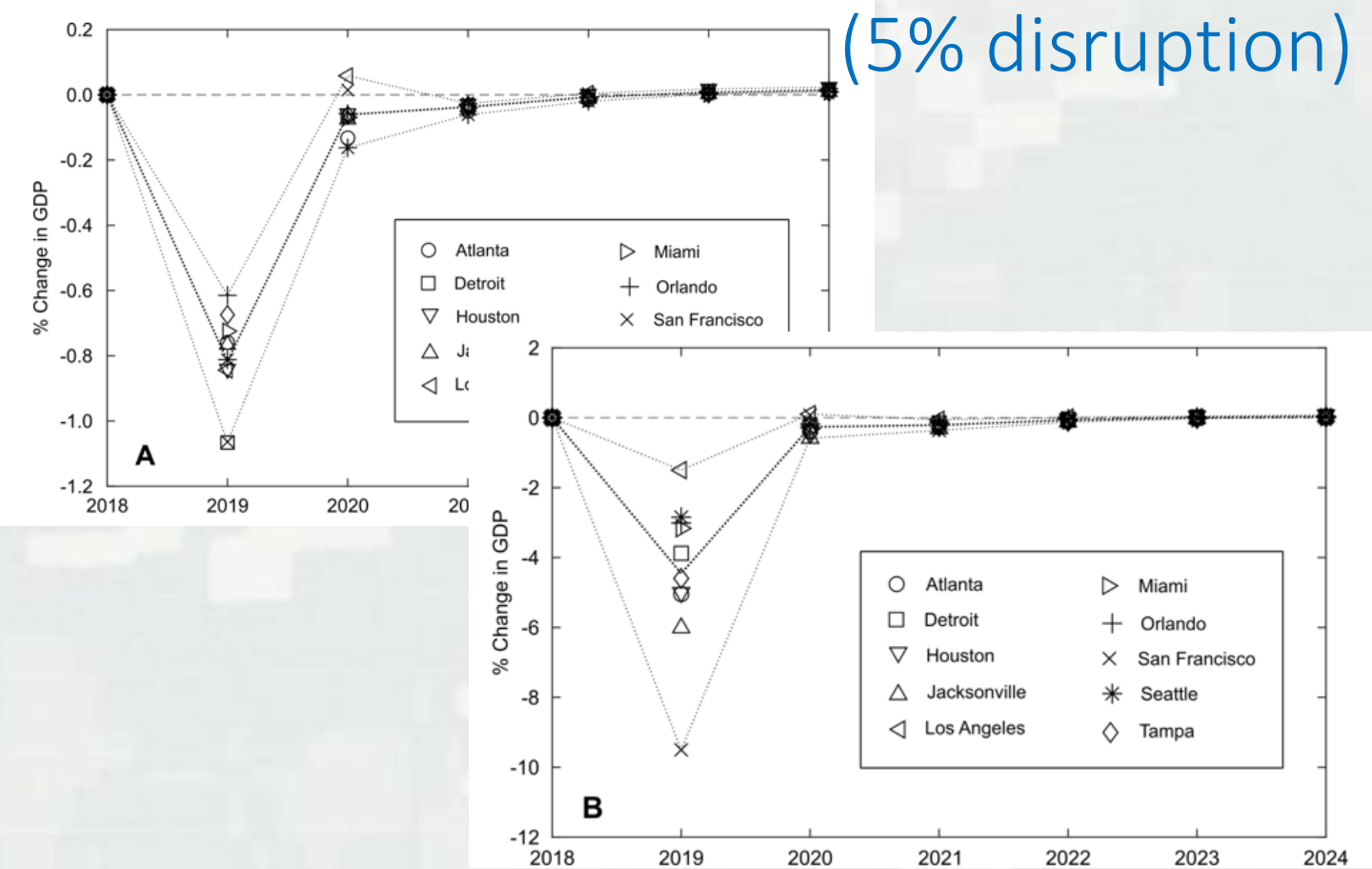
Scenario 2

Resilience Model

Interested in:

1. Temporal Patterns of Disruptions
2. Compare Multiple Cities

Temporal Pattern of Recovery) (5% disruption)



Increase in Transportation Costs

Transportation Cost Increase, $c(\rho)$	Fraction of Affected Roadways (Network Links), ρ				
	1%	2%	3%	4%	5%
Atlanta	4%	10%	16%	23%	**33%**
Detroit	3%	6%	9%	14%	19%
Houston	5%	11%	16%	24%	**32%**
Jacksonville	7%	13%	22%	**33%**	**44%**
Los Angeles	1%	3%	5%	7%	9%
Miami	4%	9%	13%	18%	23%
Orlando	4%	9%	14%	20%	**26%**
San Francisco	9%	20%	**34%**	**43%**	**51%**
Seattle	3%	6%	9%	13%	17%
Tampa	6%	12%	20%	**26%**	**37%**

Contents lists available at ScienceDirect

Transportation Research Part D

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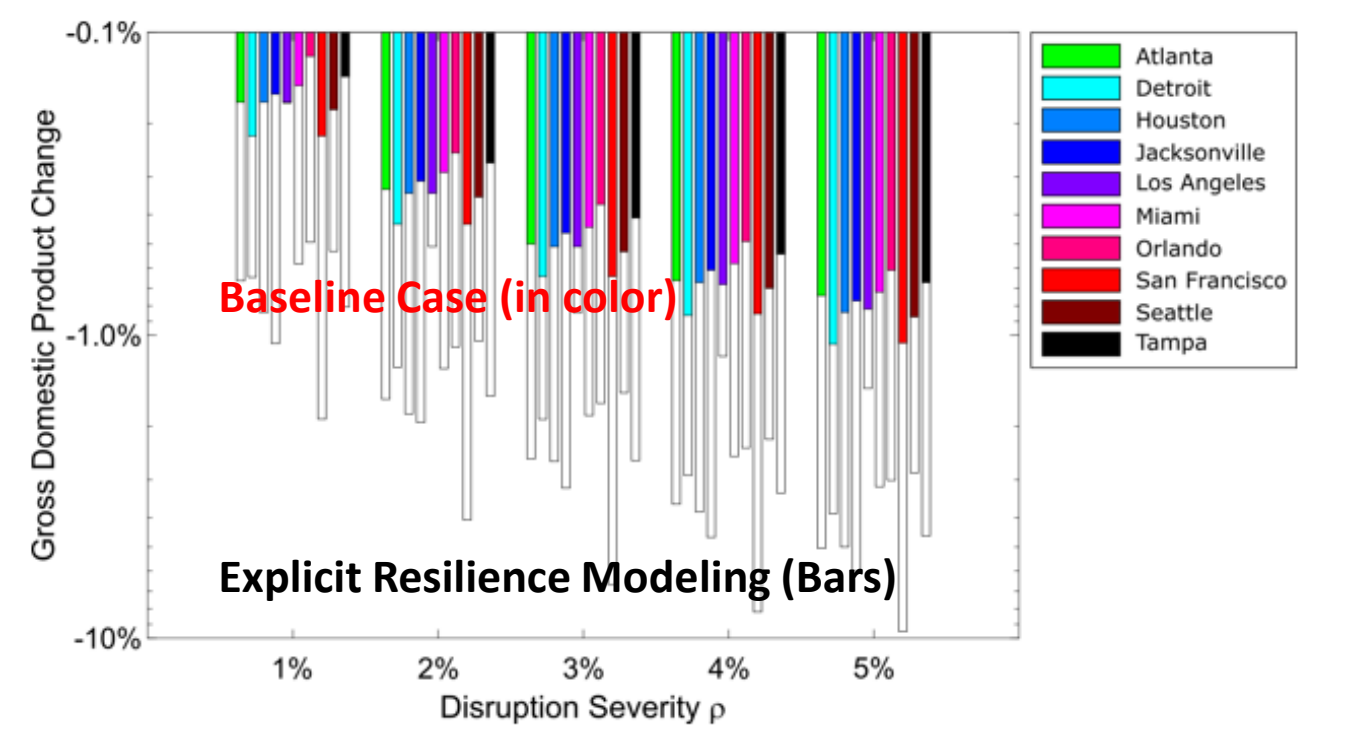
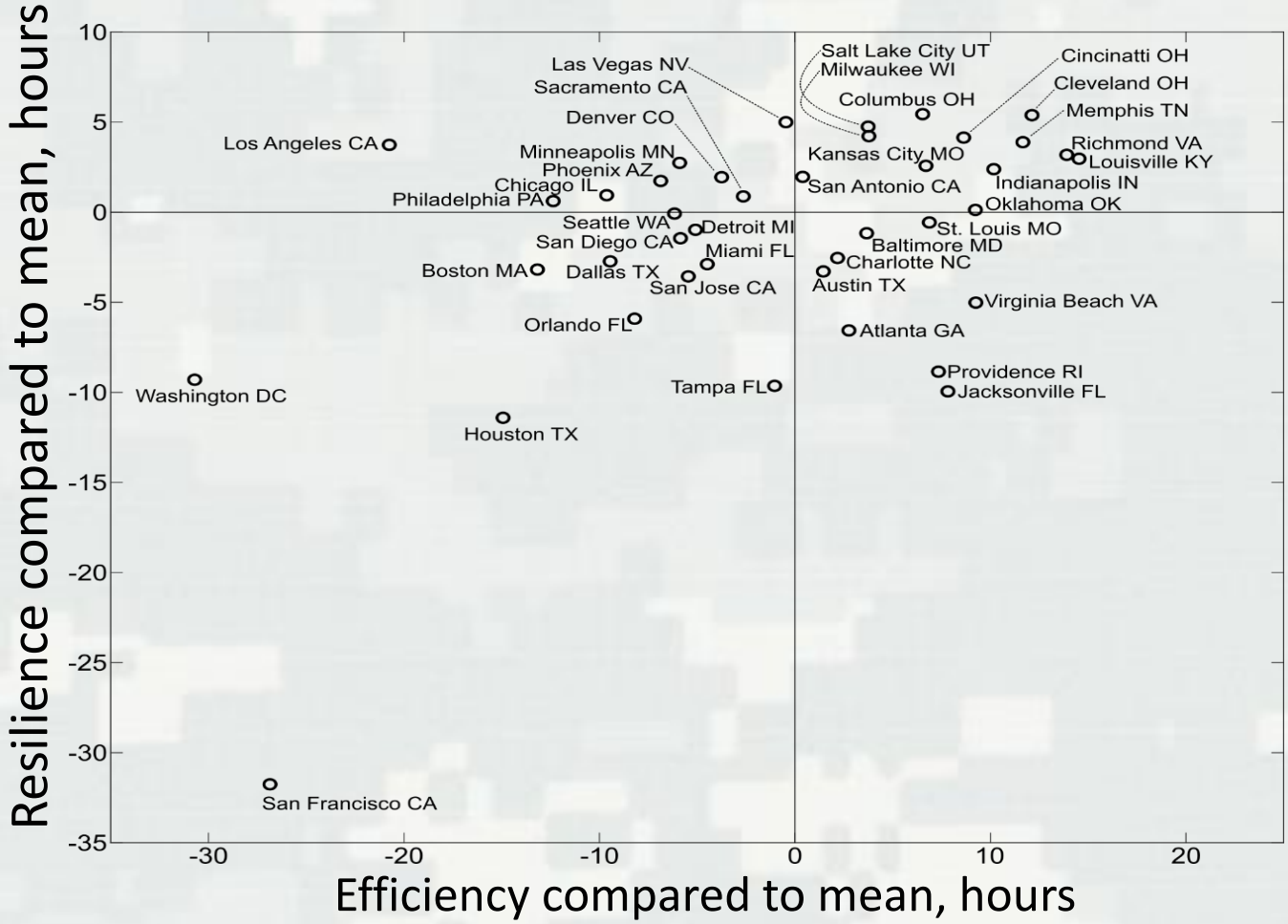
Lack of resilience in transportation networks: Economic implications

Impact on GDP



Resilience vs Efficiency at 5% disruption



SCIENCE ADVANCES | RESEARCH ARTICLE

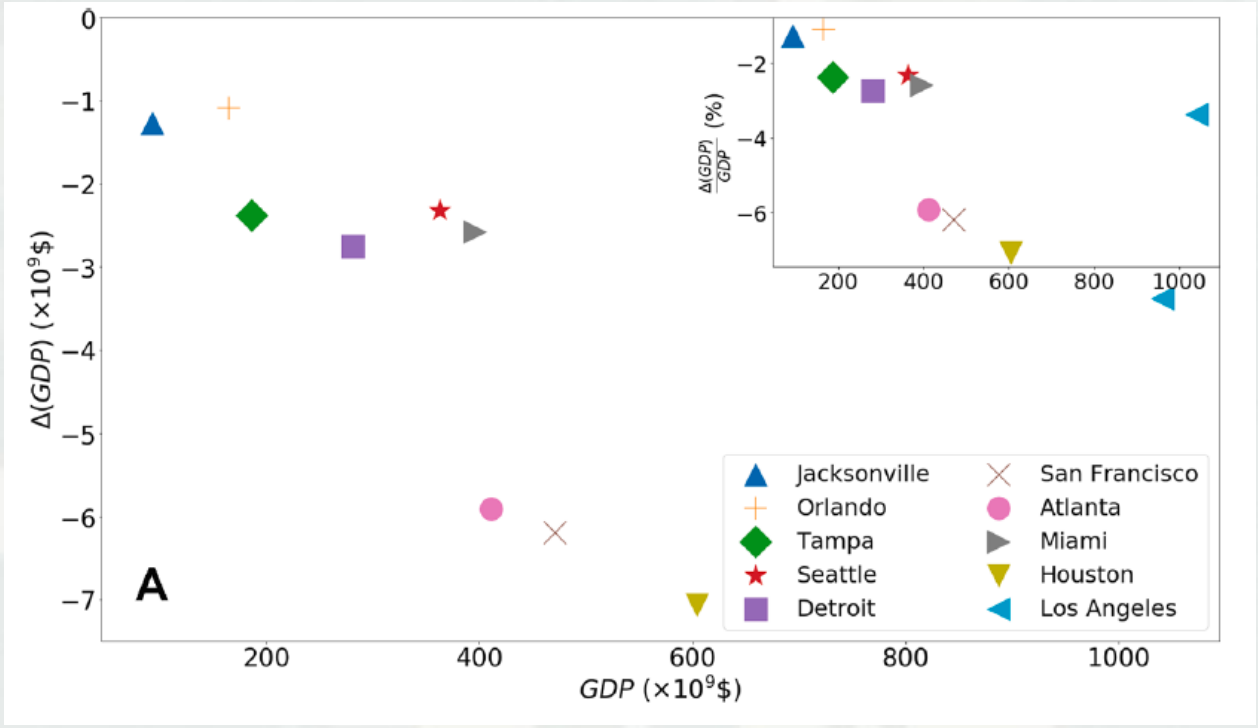
NETWORK SCIENCE

Resilience and efficiency in transportation networks

Alexander A. Ganin,[1,2] Maksim Kitsak,[3] Dayton Marchese,[2] Jeffrey M. Keisler,[4] Thomas Seager,[5] Igor Linkov[2]*

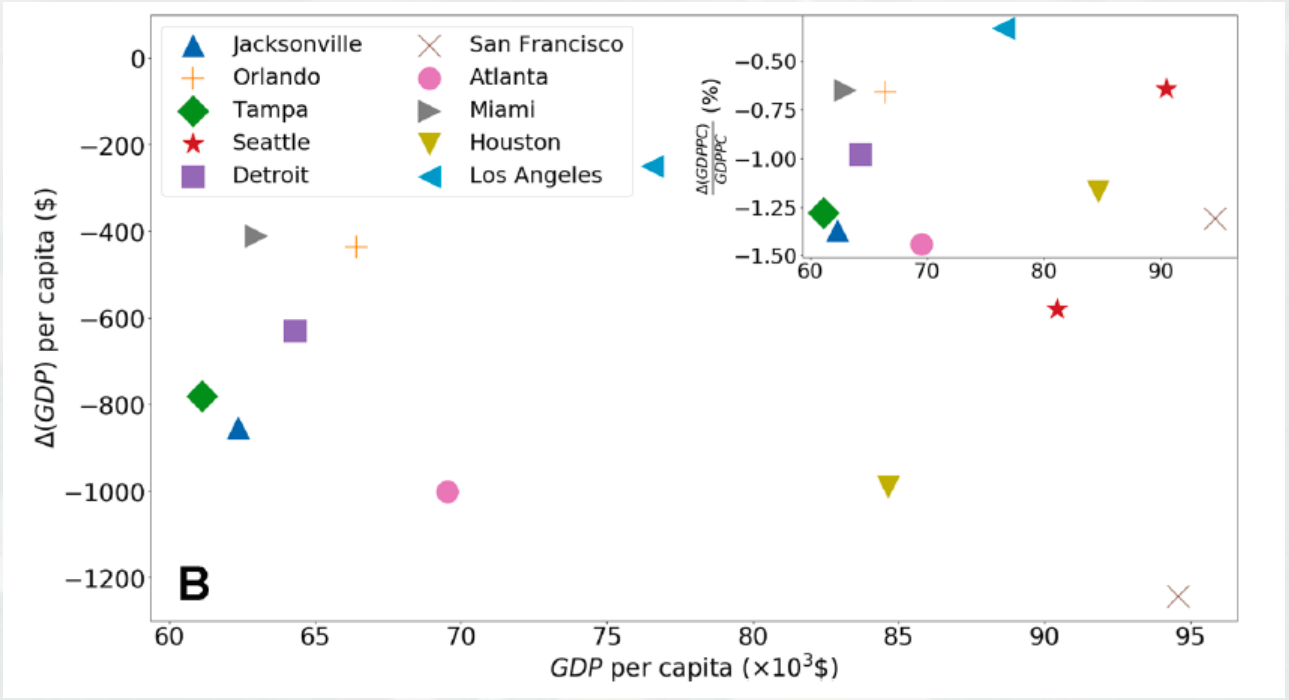
2017

Resilience in Big Cities



After Kurth et al., 2020

Resilience in "Rich" Cities

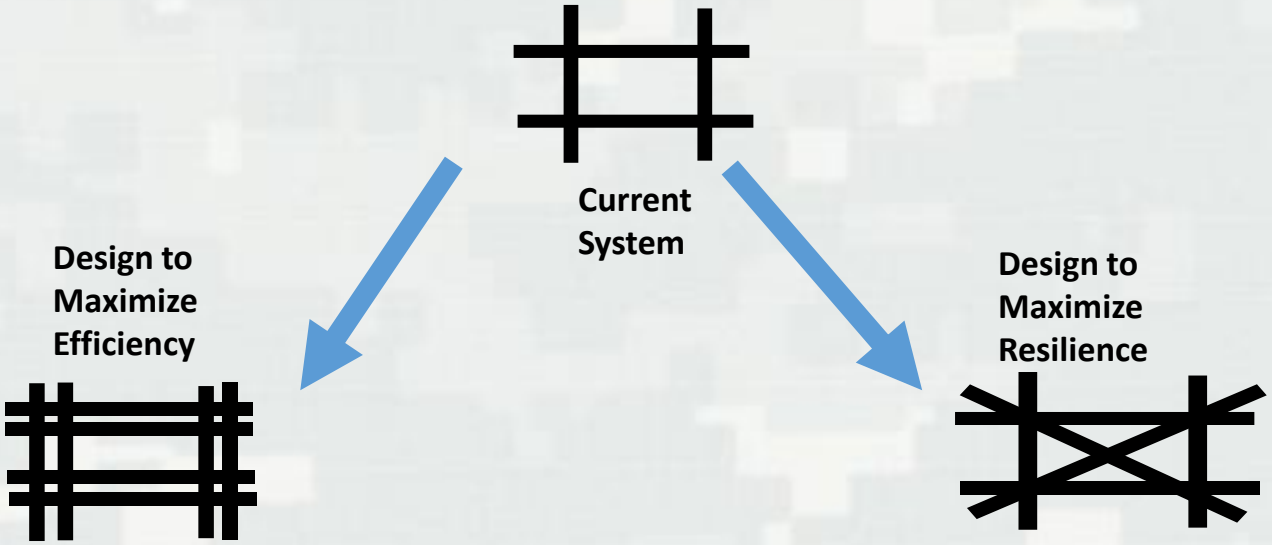


Resilience

GDP Per Capita

After Kurth et al., 2020

Managing Resilience is Different than Efficiency



Efficiency

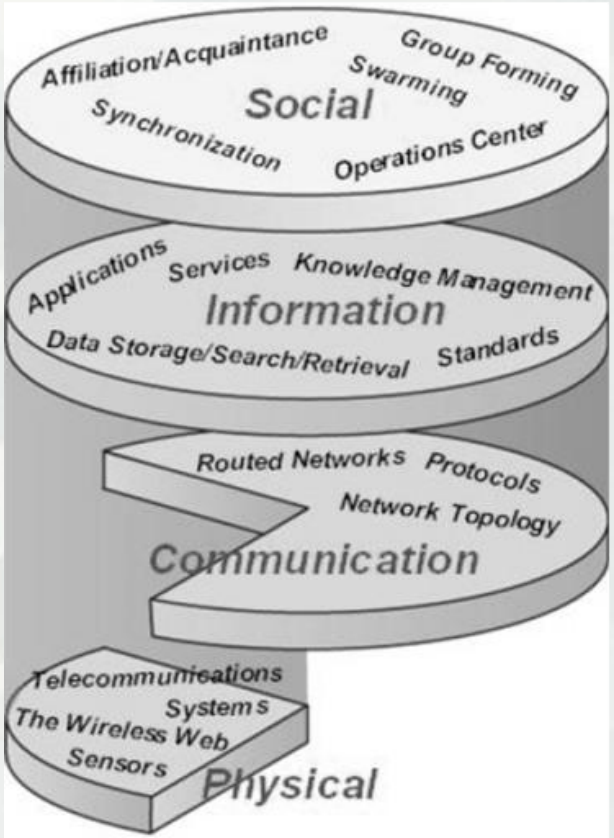
- the ability to move quickly when the network is functioning as designed
- cost effectively improved by increasing capacity on existing and highly utilized right of ways

Resilience

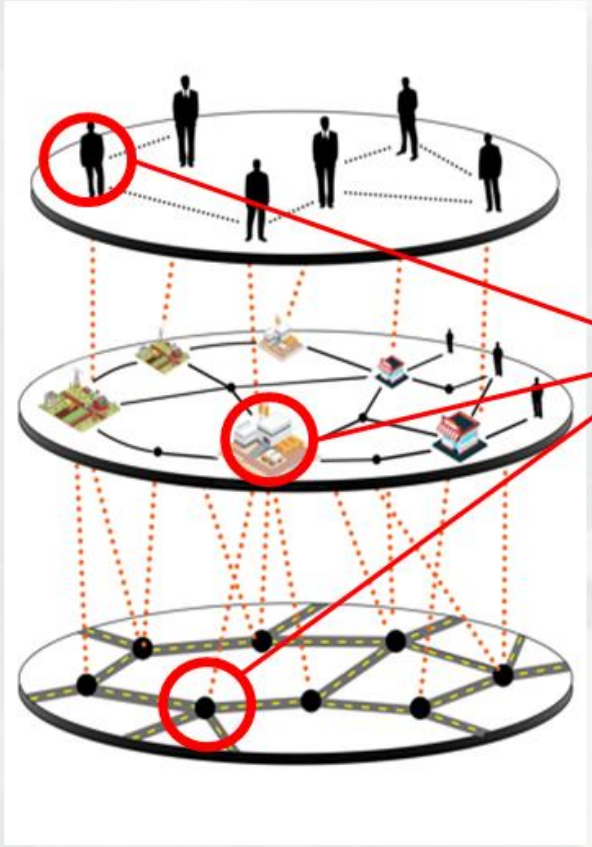
- the ability to limit delays from network component failures
- best improved by provide alternative route capacity when failure does occur

Vision for Analytics Related to Cruise Tourism

Real World



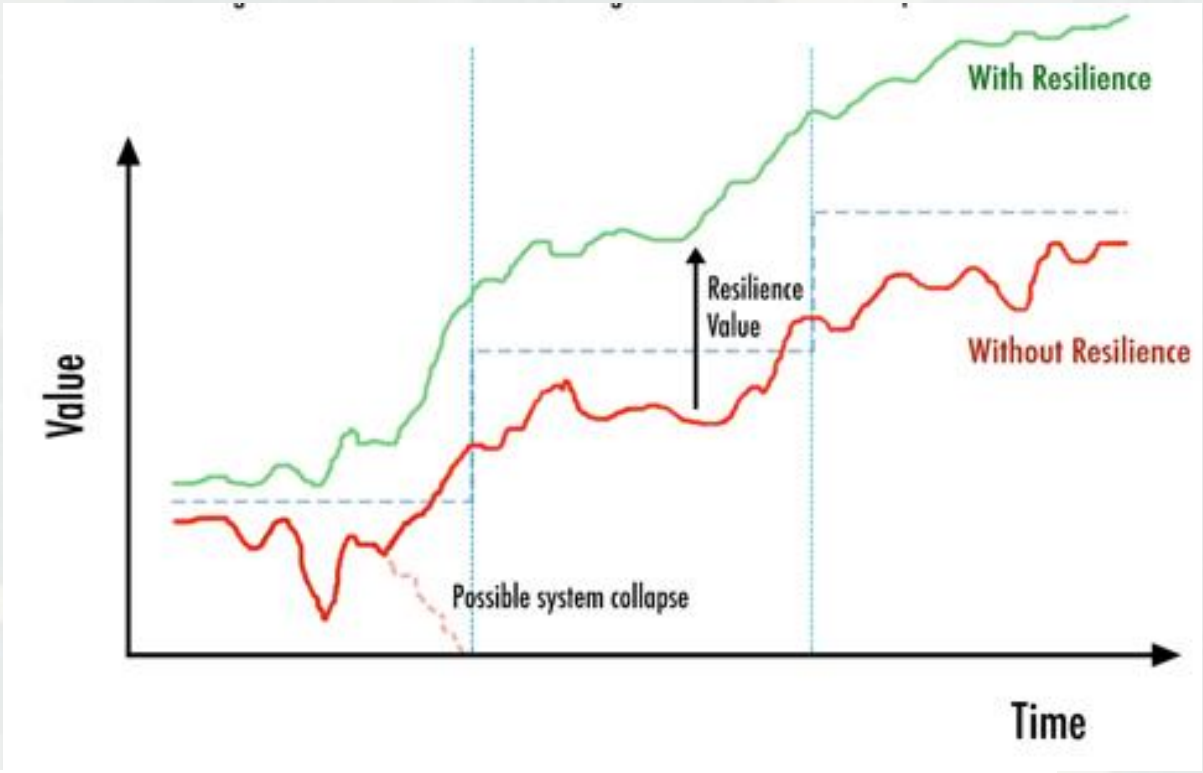
Model



Operations

Management Alternatives

Value of Resilience



2020

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The case for value chain resilience

Igor Linkov, Savina Carluccio, Oliver Pritchard, Áine Ní Bhreasail, Stephanie Galaitsi, Joseph Sarkis and Jeffrey M. Keisler

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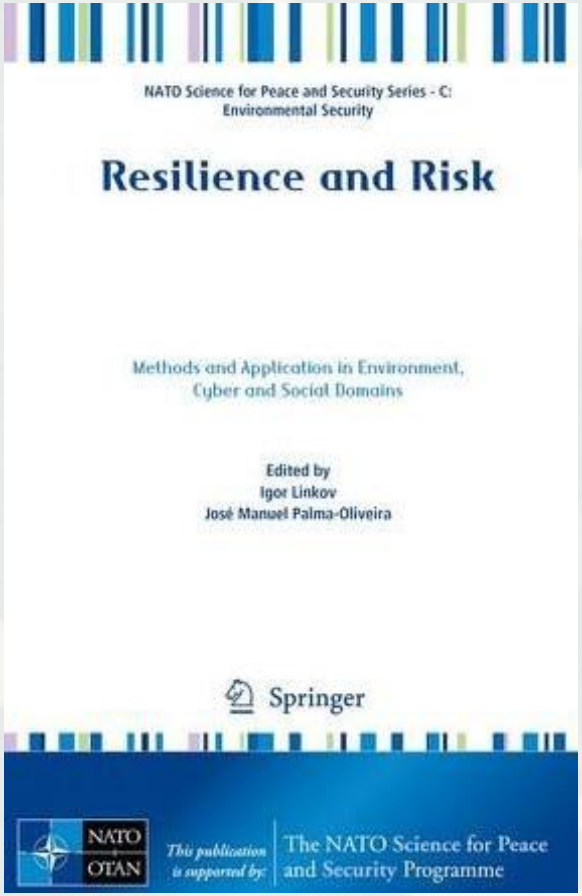
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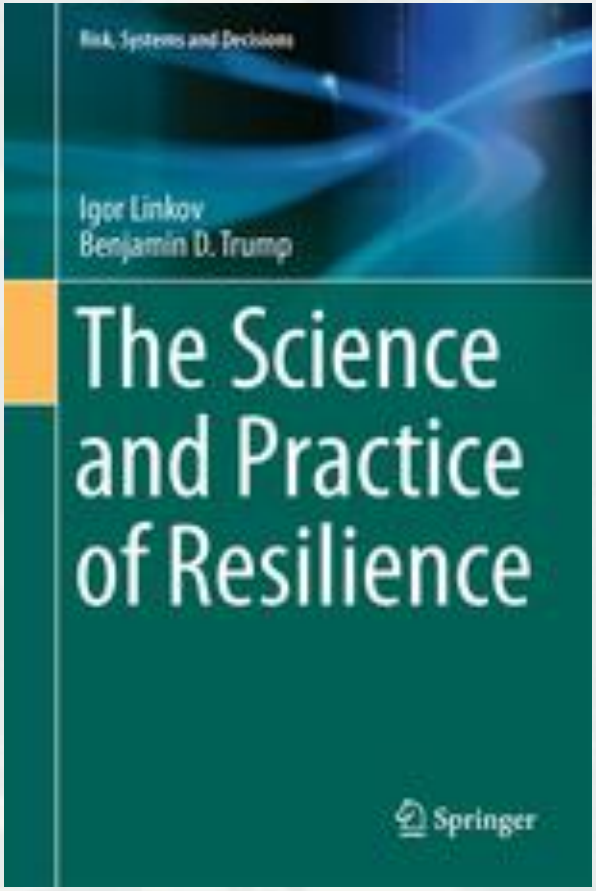
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