G7 ITALIA 2024

MOST

POLITECNICO MILANO 1863

G7 Transport Academic Workshop

Introduction to the workshop

Pierluigi Coppola
DMEC – Politecnico Milano

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Introduction

We live in an era characterized by great changes. Technological transformations are profoundly changing society in all aspects of daily life: from work, to mobility, to the ways in which individuals interact and do leisure. The ability to adapt and embrace these transformations will determine the success of communities in the future.

Moreover, the increasing frequency of unexpected events at local and global scale (such as pandemics, wars and terrorism, extreme environmental events, ...) can create disruptions to transport systems preventing person mobility and seriously affecting efficiency of supply chains. Although these "shocks" are typically short-lived, they can have long-term repercussions and effects on mobility, as well as having negative outcomes on other sectors (e.g. tourism) and on the economy in general (GDP, jobs, etc.).

In line with the topic selected by the Italian Presidency of the G7 Transport, i.e. "*The Future of Mobility: ensuring global connectivity in an uncertain World*", Politecnico Milano and the Italian Centre of Sustainable Mobility (MOST) has organised a scientific workshop to discuss best practice, approaches and methods for planning robustness and resilience of transport systems.

The workshop will bring together scholars, researchers and practitioners from the G7 countries, who will discuss how to create mobility systems capable of adapting to extreme and unexpected events, capable of resist shocks and recover quickly.

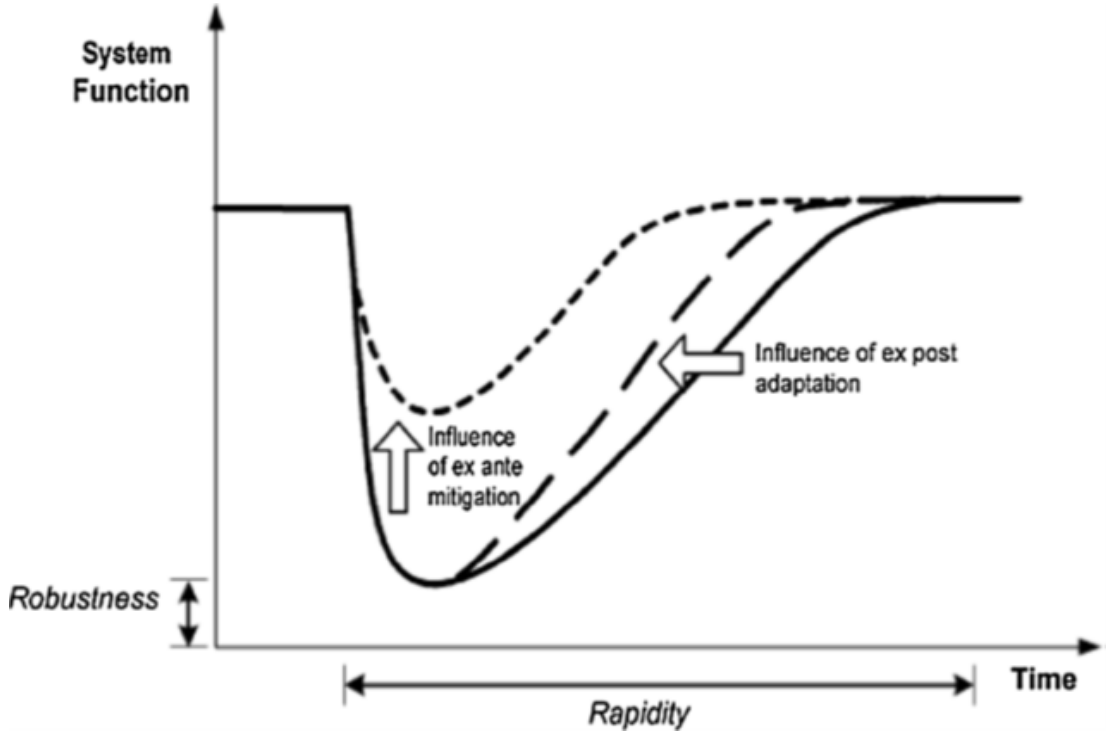
Resilience as *robustness* and *rapidity-to-recovery*

The resilience of a transport system can be defined as the capacity to deal with, adapt to and recover from disruptions, i.e. severe and sudden shocks (often unexpected). Two elements need to be distinguished here: the robustness and recovery capacity of systems.

The **robustness** of a system determines how large the deterioration of the system functions is due to the disruption.

The **recovery capacity** determines the time needed for a transport system to get back to the service level or level of operations before the disruption took place. In engineering literature there is a tendency to focus on the capacity to get back to the old equilibrium, whereas ecological literature has stressed the possibility of moving towards new equilibria.

Improving robustness can be considered mitigation, whereas recovery capacity is an adaptation measure.



Source: McDaniels et al. 2008

Adaptation vs. **Mitigation** policy actions

There are three types of mitigation measures:

i) **Avoid**. Measures to avoid disruptions reduce the probability that the disruption takes place.

ii) **Coping capacity**. Measures to increase the capacity of the system to disruptions when they take place so that the system functions are minimally impacted.

iii) **Redundancy**. Alternative capacity in case disruptions take place.

There are two types of adaptation measures:

- **Response measures**, i.e. measures to deal with the immediate impacts of the disruption; a necessary step before recovery can take place.
- **Recovery measures,** i.e. measures put in place to restore system functions.

There is a strong inter-relation between mitigation and adaptation measures. Mitigation reduces the need for adaptation as it decreases the likeliness and exposure to disruptions, but mitigation could be more expensive than adaptation in certain circumstances.

In which circumstances is mitigation more expensive, and when does mitigation or adaptation make most sense?

The **trade-off between mitigation and adaptation** differs per transport sector and the design of the networks in those different sector, e.g. centrally connected networks (hub-and-spoke) are less robust, but most reactive to response actions. So, for sectors with such network structures (aviation, container shipping) disaster preparedness is most critical Moreover, certain mitigation measures, e.g. relocation, could be too expensive until the disruption has happened.

International cooperation could focus on defining good policy practices for robustness and recovery and clarifying which measures have worked under which conditions. As part of this cooperation, policymakers could define a tool for incorporating disruption related costs (costs of disruption, mitigation and adaptation) into transport investment decision-making.

Assessment tools

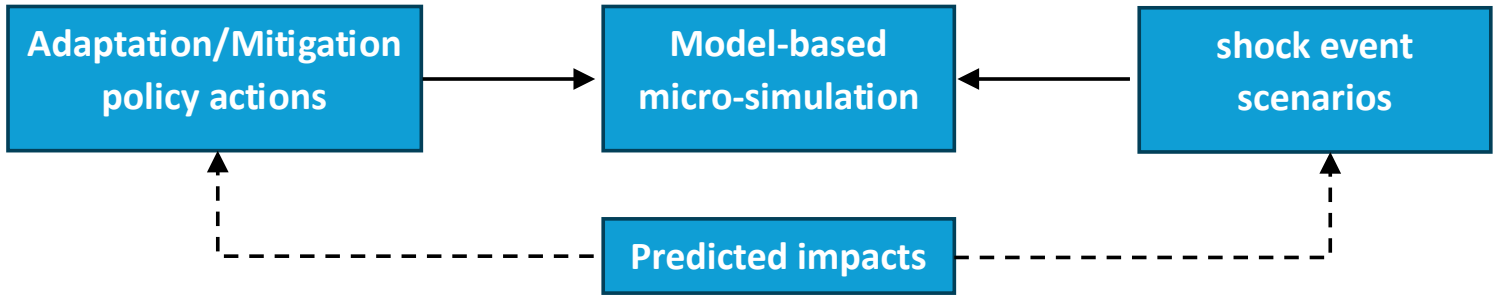
The identification of assessing criteria and tools for the ability to resist and adapt to unexpected events concerns the times necessary to restore the original mobility services or transport activities (as before the unexpected event) as well as the necessary costs of restoration.

Assessing current and predicting future vulnerabilities of transport systems is an essential constituent of the activities that policymakers need to undertake to prepare increasing the resilience of transport systems, because it can make their policy actions more focused. Despite progress in predicting risks, huge uncertainty continues to exist on future disruptions.

There are tools that could be used to be better informed about potential risks, including indicators on the performance of existing transport systems, indicators on recovery time in case of a disruption, risk assessments and predictions of essential (physiological and safety) human needs via analysis of network characteristics, **digital twins or transport modelling.**

In fact, prediction of impacts cannot be exclusively data-driven but requires modeling and simulation experiments.

Decision-making on transport policies and investments could benefit from such tools for assessing the impacts from disruptions to transport systems and indicators to assess the resilience of transport networks.



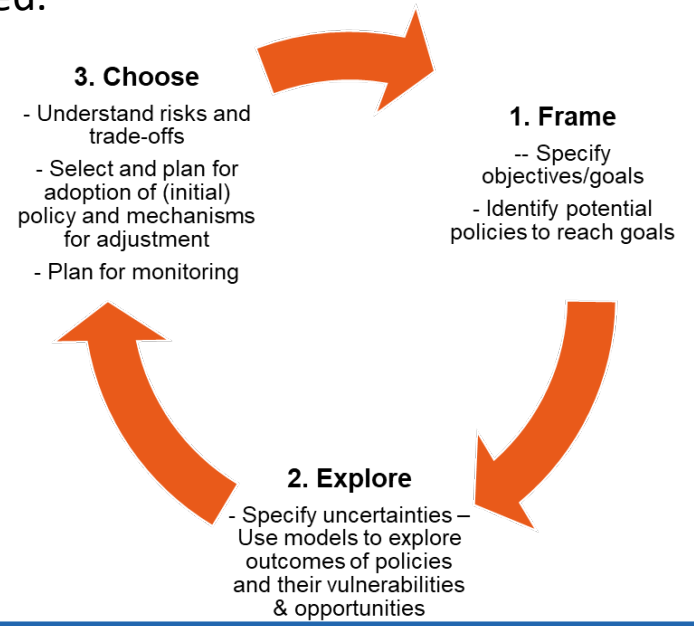
Appraisal processes towards **robust adaptable plans**

The traditional appraisal processes and techniques have changed significantly in recent decades, by incorporating analysis of the wider economic benefits, and have progressively broadened the scope of cost–benefit analysis (CBA) to capture more impacts that are difficult to express in monetary values.

Despite these changes, significant modification of appraisal practice might be required to ensure that considerations on unexpected shock-resistance of transportation are appropriately valued. The need for shock-resistant transport policies has increased calls for changes to the way transport investments are reviewed and selected. It requires the use of complementary appraisal methods.

The literature defines '**deep uncertainty**' a situation in which analysts do not know or cannot agree on: i) models that relate key forces that shape the future; ii) probability distributions of key variables and parameters in these models; iii) the value of alternative outcomes.

"**Decide and Provide**" is an approach to planning in an environment of deep uncertainty, where future risks and uncertainties are recognized and policy pathways are tested across a wide range of possible future conditions. This analysis identifies "robust policy and investment decisions" to meet visions and goals. Monitoring is undertaken to identify signals when mitigation actions are required.



Global Coordination

There is a need to deal with the disruptions of transport systems at a global level and in a coordinated manner. Many crises are of a global nature or have global impacts due to cascading effects.

National transport policies may have more impact if coordinated with those of other countries, for example with respect to competition policies for global transport industries.

There is also a huge potential for peer-learning on how to deal with disruptions to transport systems, e.g. in the domain of de-risking transport systems and diversifying supply chains. **De-risking transport systems** and supply chains entails decreasing the exposure to risks. Tools for de-risking could include mapping of risk exposure, identification of critical functions and products for which alternative options and suppliers would need to be explored, and designing a strategy that could make this happen. Governments could share best practices in this regard and ways to promote their implementation.

There is also significant potential to take more robust decisions incorporating future uncertainty.

The **role of research** is crucial to develop innovative and interdisciplinary approaches and creating a common base-knowledge.

Building relationships allows for the exchange of knowledge and different perspectives, enhancing innovation and amplifying the impact of scientific discoveries. In particular, the creation of new links between **Academy and Industry** is fundamental to translate research results into practical and impactful solutions, to face the challenges of decarbonisation/sustainability, digitalisation and social changes.

To this end, planning and design of transport systems need to leverage a **collaborative approach and strong international and cross-sector networks**.

Workshop Agenda

The studies and best practices that will be presented during the workshop aim to improve base-knowledge and create awareness among decision-makers about the urgency of a paradigm shift in transport planning and policy.

Presentations concern the following topics:

1. Design principles and metrics for transport networks resiliency according to redundancy, diversity and modularity and for ex-ante analysis of impacts through simulation models of transport systems;
2. Identification of assessing criteria for the ability to resist and adapt to unexpected events;
3. Examples of best practices in taking more robust decisions in the face of growing uncertainty in factors that influence transport;
4. Examples of best practice in managing critical situations including the extent of the repercussions on transport systems in the short and long term, as well as the effects on other economic sectors.

The workshop consists of 4 sessions

- Session 1: introduction and keynote speeches
- Session 2: Design Principles and Measures for network resilience
- Session 3: Decision-Making and Trade-Offs
- Session 4: Policies and Practices for Mitigation and Adaptation

Prof. Pierluigi Coppola

DMEC - Politecnico di Milano

Pierluigi.coppola@polimi.it

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