

# Resilience and Sustainability Impact Assessment Framework for Port Quay Walls



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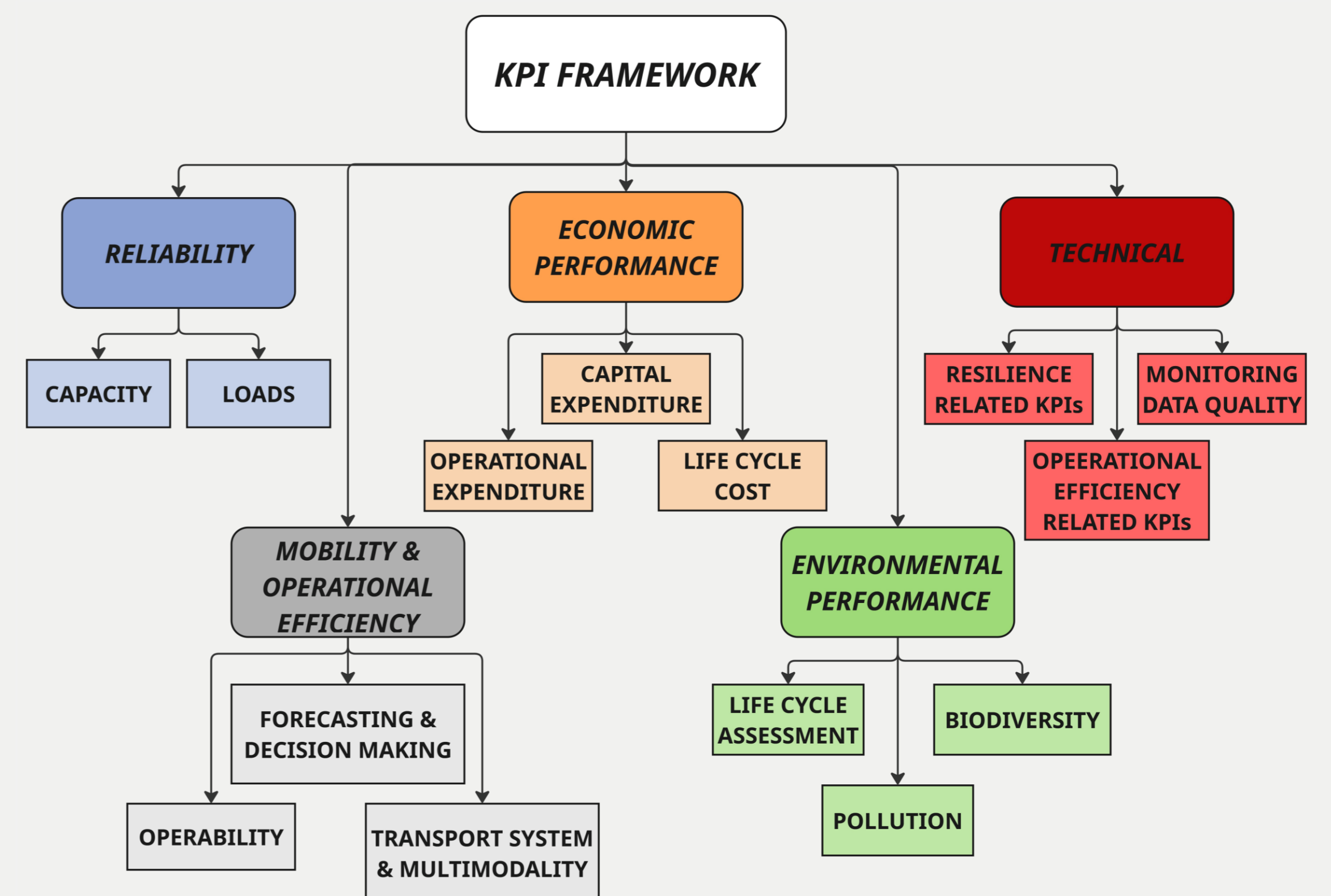


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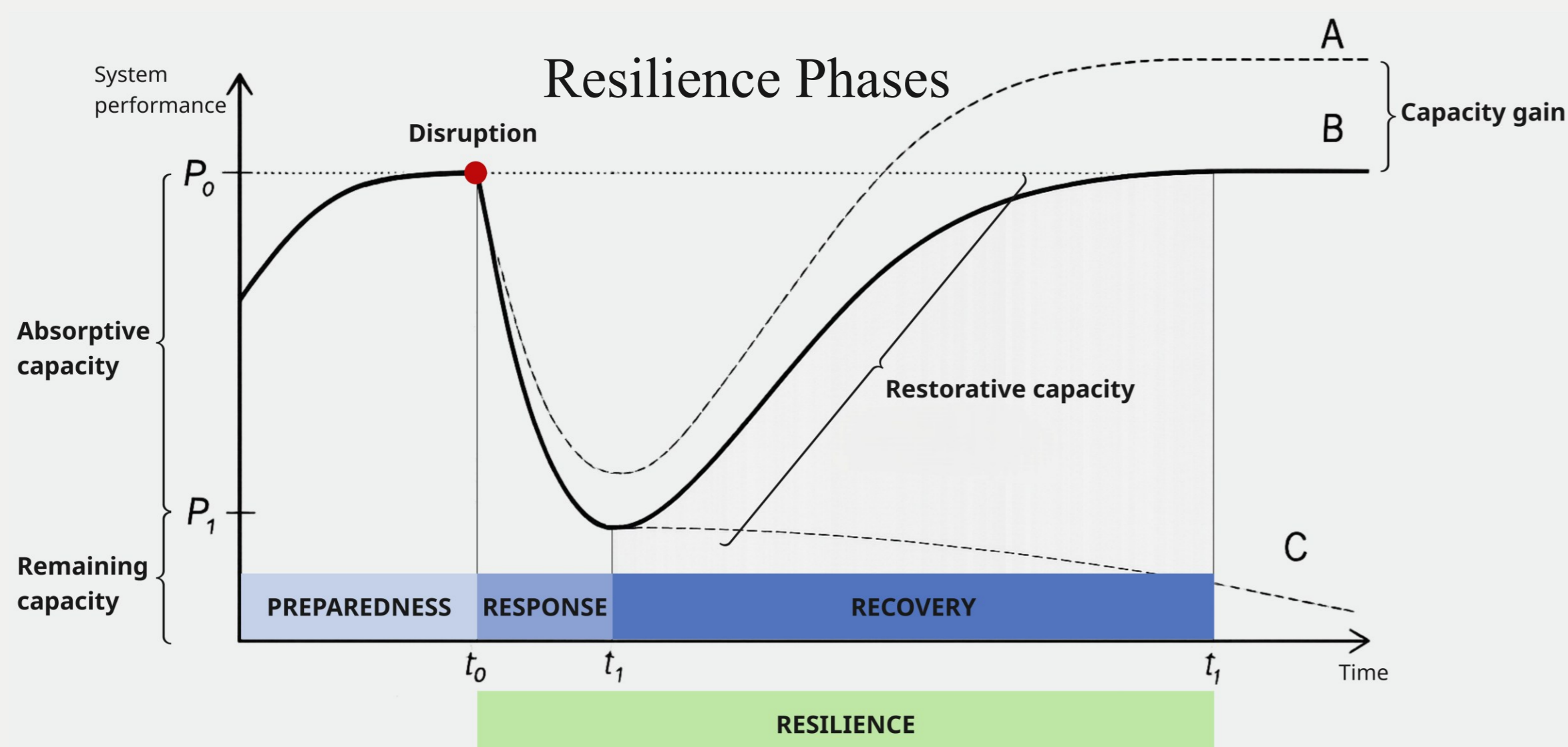
## Introduction

- Ports are critical nodes of global trade, increasingly exposed to climate hazards
- The **CLARION** project aims to advance research in the field of port infrastructure resilience and its hinterland transport networks by enhancing operational safety, security and environmental sustainability.
- This paper presents the resilience and sustainability impact assessment and the Key Performance Indicator (**KPI**) framework to evaluate and measure the impact

## Methodology



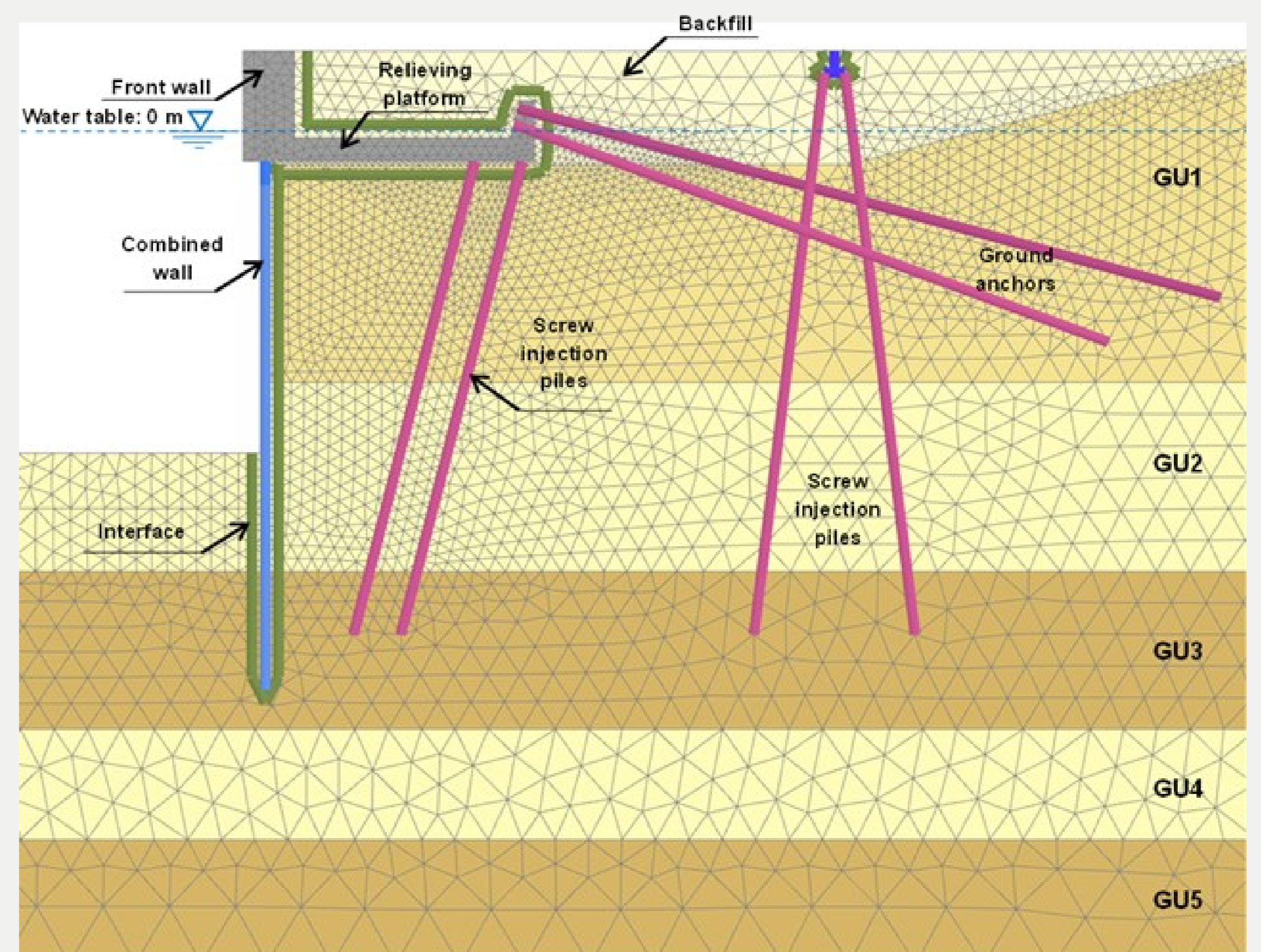
## Resilience & Sustainability



- Resilience** – ability to maintain acceptable level of service despite disruptions
- Sustainability** – business strategies and activities that address the present and future needs of the port and its stakeholders, while safeguarding both human and natural resources

## Case Study – Smart & Sustainable Climate Resilient Quay Walls

- Fibre optic sensors embedded in **quay wall** elements, feeding a **Digital Twin** validated against a 2D model
- Enables a shift from assumption-based design to condition-based predictive maintenance
- KPIs applied**
  - Reliability:** Safety factor, Service life
  - Economic performance:** Construction & Operation and Maintenance cost
  - Environmental performance:** Circularity, LCA total impact,
  - Technical:** Digital model repurposing



## Conclusion

- Resilience and sustainability are complementary – more resilient infrastructure is inherently more sustainable, and vice versa
- Sensor and Digital Twin deployment can extend quay wall service life, reducing lifecycle costs, emissions and material impact simultaneously
- Holistic frameworks like this are essential for multi-criteria investment decisions in port logistics

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