Enhancing the resilience of infrastructure: SPACES principles

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Introduction

Resilience of critical services has **never been more important**

Without resilience, there are suboptimal economic and social benefits, and risk of environmental harm

Convergence of challenges to resilient infrastructure:

- growing inter-connectedness of the world, globalisation
- rising risks of disasters, amplified by climate change, more intense and frequent hazards
- need to multiply infrastructure capacity to meet demand
- regulation and legislation toward decarbonisation

Scope

Extend the UN definition of resilience

- take the broadest view of resilience including the **design** of resilient ready infrastructures**; upgrades** and integration with legacy infrastructure, as well dealing with how critical services are not made less resilient by **end of life and decommissioning** of infrastructure sub-systems
- Nationally defined statement of **tolerance for irresilience**: acceptable minimum level

> **Resilient infrastructure definition**
>
> The ability of an infrastructure system exposed to hazards to resist, absorb, accommodate, adapt to, transform, and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management, and planning and design for old and new structures and functions which will integrate with legacy and overall provide a nationally defined acceptable level of critical services.

Direction of change

Realised long term gains	IMPACT	Less harm, less loss of life, less asset damage	Greater investor confidence	Less environmental harm	Less inconvenience and wasted resources
Tangible short term benefits	OUTCOMES	Fewer failures and near misses through better resisting and absorbing hazards	Rise in national resilience of critical services by better accommodating, adapting, transforming and recovering in the face of hazards		Increased knowledge
Net resilience gain	OUTPUTS	Infrastructure projects and enhancements are delivered "resilient ready"			Regulator reports
Standards, regulation, guidelines	INPUTS practice	Infrastructure projects and enhancements must demonstrate how they implement the principles			Regulator monitoring
Geo-political leadership; asset diversity	INPUTS policy	Principles become national standards	National adoption and tailoring with statement of tolerance of outages		

Feedback

Theory of Change

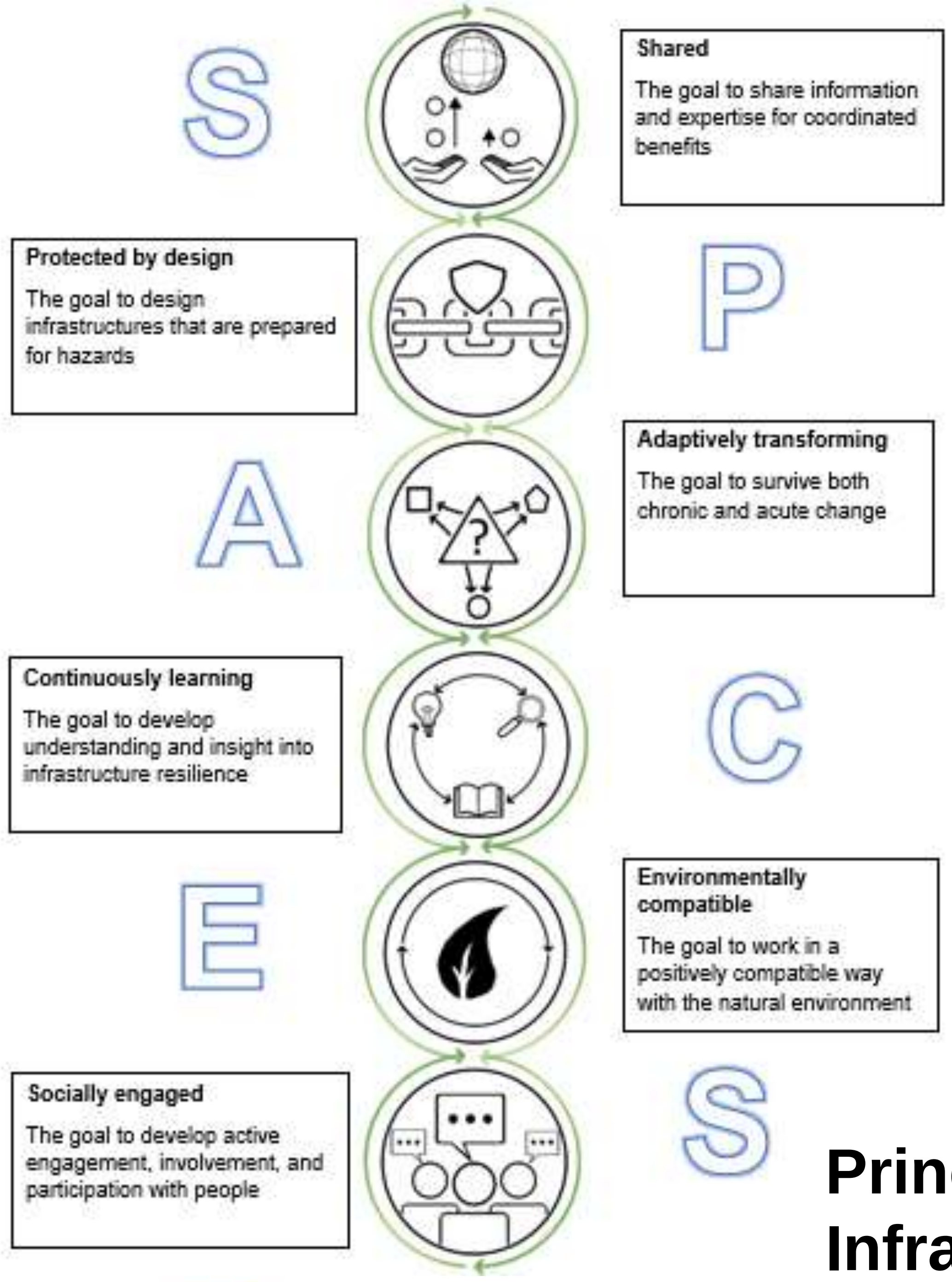
Economic viability

$6 million spent on the seismic strengthening of transmission and distribution infrastructure resulted in a $30 million to $50 million **reductions in direct asset replacement costs**

Hurricane Sandy, New York City damaged kilometres of copper cables with estimated losses of $1 billion. **Transform** networks with fibre-optic cables, more resilient to water damage

accounting for climate change in the **design of infrastructures**, in Bangladesh, increased capital requirements by $560 million for additional flood protection but could **save up** to $1.6 billion

analysis of OECD countries shows every additional $1.0 spent on infrastructure maintenance is **as effective as** $1.5 of new investment



- Shared
- Protected by design
- Adaptively transforming
- Continuously learning
- Environmentally compatible
- Socially engaged

Principles for Resilient Infrastructure

UNDRR
UN Office for Disaster Risk Reduction

CDEMA
CARIBBEAN DISASTER EMERGENCY MANAGEMENT AGENCY
Resilient States - Safer Lives

(P1) Shared

The goal to share information and expertise for coordinated benefits

The Peru Rural Roads Program (known as PCR) is an example of how **community participation** in a large-scale rural roads program can contribute to rural transport, local economic development, and local governance.

Kenya has adopted a polycentric approach, giving **local communities the autonomy to implement locally appropriate approaches** to water governance, and creating institutions to encourage communication and coordination between communities, and promote shared decision-making among local, regional, and national authorities

(P2) Protected by design

The goal to design infrastructure that is prepared for hazards

Durban, South Africa is designing their stormwater infrastructures and drainage infrastructures as an integrated system to **account for estimated 15% increase in rainfall by 2065**. Their actions consider **infrastructure interdependencies** to mitigate risks of flooding from the city's river.

Composites can play a key role in **rehabilitating crumbling infrastructures** to achieve resilient design. Fibre-reinforced polymer bridge decking was used to rehabilitate two pedestrian overpasses in Atlanta, Georgia, U.S., replacing heavy, decaying concrete with durable, corrosion-resistant composites

(P3) Adaptively transforming

The goal to survive both chronic and acute change

In 2011 officials broke through a section of the Assiniboine River dike Winnipeg, Canada, to facilitate the **controlled release** of floodwaters preventing a severe breach downstream, which could affect 850 homes and an area of 500 square kilometres

The Sand Bag House was built on a development on the outskirts of Capetown in a bid to address the area's housing shortage in a way that would conserve money and resources. The home uses **inexpensive local materials which cuts down on transportation, and created a local 'future-resident' community workforce**.

(P4) Continuously Learning

The goal to develop understanding and insight into infrastructure resilience

Morocco is **modeling** natural hazards for coral reef management and rehabilitation alongside other nature-based solutions and grey infrastructures **to reduce vulnerability to flooding and erosion** while maintaining the beauty of the coastline.

The Rising Main Monitoring Project **improves knowledge of asset issues** such as blockages, sticking/passing non-return valves, worn pumps and burst mains, helping both asset planners and operational teams, with fault diagnostics and early detection for timely action.

(P5) Environmentally Compatible

The goal to work in a positively compatible way with the natural environment

Implementation of **green roofs** increases roof longevity because the membrane is protected from weather conditions by the soil layer, but it also has a direct impact on air quality improvement and energy saving. **Coral reefs** halve the risk of damages from flooding and cut the costs from frequent storms to one third. **Well-anchored vegetation can reduce landslide risks,** whilst **deforestation** can increase surface runoff and soil erosion, adding to flood risk downstream	Hurricanes Irma and Maria severely damaged the power grid in Puerto Rico, largely because of **trees falling on the transmission lines** resulting in lost power for more than a week and recovery left many customers in the dark for several months. Reinforcing poles is less efficient than **trimming trees**.

(P6) Socially Engaged

The goal to develop active engagement, involvement and participation with the people

Theft of railway tracks, copper cables, etc. interrupt critical services. In Zambia, vandalism was addressed by **<u>increasing the community's sense of ownership</u>** by introducing a fair financial contribution to construction costs.

<u>Home energy reports</u> to households giving feedback on past energy use, comparing their usage to neighbours, and provide energy saving tips provides strong evidence that this social reward approach can **<u>nudge residents to reduce energy use</u>**. Providing data and information must be in a way which is understandable for them so they can derive actions. Subsidies also have a key role in **<u>domestic engagement</u>**.

Thank you

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