Climate adaptation for water infrastructure

DETAILS
SECTOR | Water, Cross-sectoral
STAGE | Strategy and planning, Finance and funding
TECHNOLOGIES | Big Data, Data & Analytics

SUMMARY
Leveraging asset level data sets with climate models can quantify the climate change risks to water infrastructure, assess adaptation options, and provide economic modelling for smarter investment decisions. The goal is to increase climate resilience of water systems through new infrastructure, and replace, retrofit or upgrade existing assets. These models are used to identify hazards caused by climate change such as rising sea levels, saltwater intrusion, drought and other extreme events, and the risks it presents to water and wastewater infrastructure such as dams, treatment plants and pipe networks. This assists asset managers and policy developers to adapt infrastructure to be more resilient to the climate.

As computing power increases, the ability to analyse large data sets also increases. Climate science projections and asset failure models comprise extremely large data sets. By linking complicated variables in climate science knowledge, specific asset infrastructure failure and cost models it is now possible to synthesise useful insights and infrastructure recommendations for complex systems.

Climate change is in the forefront of immediate and long terms policy and infrastructure decisions. The World Bank (2010) estimates that the cost of climate adaptation between 2010 and 2050 is in the range of $75 billion to $100 billion a year\(^1\). While the United Nations Environment Programme estimates the costs of climate adaptation could range from $140 billion to $300 billion by 2030, and between $280 billion and $500 billion by 2050\(^2\). Increased incidence of extreme events, such as floods, can cause disturbances and significant damage to all infrastructure, including water treatment plants and distribution networks. Technology and innovative solutions are needed to enable strategic and critical infrastructure to adapt to changing conditions. Water networks are already under stress due to increasing demand and aging infrastructure, and a lack of appropriate investment responses will lead to additional pressures. This can lead to worse health and economical outcomes and increase the potential for conflict where water resources are scarce.

Modelling is an important first step to prevent climate induced water infrastructure failure. Cost benefit analysis of potential planning scenarios and infrastructure decisions will assist asset owners to develop better

\(^1\) Margulis, Sergio; Narain, Urvashi; Margulis, Sergio; Narain, Urvashi;. 2010. The costs to developing countries of adapting to climate change: new methods and estimates - the global report of the economics of adaptation to climate change study (English). Washington, DC: World Bank.
justification for infrastructure investments. These investments will help increase capacity to mitigate these risks and are key to minimising damage to infrastructure and ensure water services are always available.

Though this use case focuses on water infrastructure, the technology can be applied to all types of infrastructure to measure their climate resilience and optimise capital investments. As modelling and analysis technology develops results will become more robust. Analysing the complicated cost and risk relationships between interdependent infrastructure such as roads, rail, water, electricity, and communications will also be achievable to assist collaboration between government agencies.

VALUE CREATED

Improving efficiency and reducing costs:
- The use of modelling and risk tools can optimise capital expenditure for new or upgrading infrastructure over the long term so that it can be responsive to climate adaptation risk.

Enhancing economic, social and environmental value:
- Help to ensure clean water and sanitation services in changing environmental conditions.

Reshaping infrastructure demand and creating new markets
- There is a potential increased need of new or different types of infrastructure depending on the results of modelling as they apply to climate change adaption.

POLICY TOOLS AND LEVERS

Legislation and regulation: Inclusion of climate adaptation modelling could be added into legislation if governments wish to make this a necessary inclusion for infrastructure developments. This would require further exploration and policy development as to what level of risk modelling needs to be included in infrastructure planning.

Procurement and contract management: As per legislation above, the inclusion of climate adaptation modelling can be included in procurement processes if governments wish to make this more of a requirement for infrastructure developments.

Funding and financing: Due to the global nature of the problem and the scale of finance needed to combat climate change, global finance and funding will need to be scaled up to ensure successful climate mitigation or climate adaptation of global infrastructure. Especially with assisting developing nations to increase the climate adaptability of their infrastructure.

Effective institutions: Collaboration between all infrastructure owners to work toward a collaborative model for interdependent infrastructure would be an ideal future state. Asset owners could assist in sharing the investment load for single government entities as well as sharing the benefits of more comprehensive climate adaptabilities studies.
IMPLEMENTATION

Ease of Implementation
Challenges will be with the available data to inform the model, as there will be multiple variables, risks, and assets to consider. Validation of risk models and cost benefit analysis will also be a challenge. This is typical a long undertaking with years of data collection and analysis.

Cost
Climate risk models and infrastructure investment cost benefit models require significant time to develop but are relatively cheap compared to the infrastructure itself.

Country Readiness
Developed countries will have the historical asset and asset failure data available to make modelling tools useful, they also have the research and governmental infrastructure to develop modelling solutions. Developing countries will rely on findings from this research.

Technological Maturity
Risk and cost climate and infrastructure modelling technology has already been used in several projects around the world. Though these projects are typically calibrated for local conditions, as computing power increases more data and variables can be input into models and potentially create universal risk models that can be used for all scenarios. The technology will need to be adaptable to as climate projections change.

RISKS AND MITIGATIONS

Implementation risk
Risk: Forecast of potential climate futures are constantly evolving. This may affect the planning and investment recommendations given by these types of technologies.

Mitigation: Plans should be developed to consider multiple future projections of uncertain variables such as population growth, population density, and climate change.

Risk: As water infrastructure affects and is affected by upstream and downstream infrastructure (such as electricity and transport), data from different government agencies will be needed to obtain results. Data management and format may differ across these entities which can lead to poor results.

Mitigation: A data management plan will need to be developed to ensure the collection of necessary data is standardised with the quality control plans to ensure optimal results.

Safety risk
Risk: Data collection, particularly regarding multiple assets spanning several utilities, government bodies and sometime different countries, can be sensitive particularly when involving risk models of critical infrastructure.

Mitigation: Plans to determine the data ownership model, the data that will be available to public and which data needs to be confidential will have to be considered.
### EXAMPLES

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<th>Example</th>
<th>Implementation</th>
<th>Cost</th>
<th>Timeframe</th>
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<tr>
<td>XDI</td>
<td>XDI Sydney is a collaboration between NSW Government and Australian climate tech company XDI Cross Dependency Initiative. It’s a large-scale, multi-utility climate risk using world-first cloud computing technology that brings together geospatial hazard maps, climate change impact projections, engineering data and financial analysis.</td>
<td>It receives about $1 million in joint funding from local governments, water, energy and transport utilities.</td>
<td>The 3 year pilot started in 2017.</td>
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<td>RESilience to cope with Climate Change in Urban arEas (RESCCUE)</td>
<td>RESilience to cope with Climate Change in Urban arEas a multisectoral approach focusing on water infrastructure in 3 cities: Bristol (UK), Barcelona (Spain) and Lisboa (Portugal). Outputs will include hazard, risk, and vulnerability assessment for urban services operation, resulting in a resilience and adaptation strategy ready for market uptake for each of the cities.</td>
<td>This project has received more than €6 million funding from European Commission by means of Horizon 2020, the EU Framework Programme for Research and Innovation.</td>
<td>A 48 month project spanning from May 2016 to April 2020.</td>
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<td>RESIN</td>
<td>The RESIN project investigated climate change adaptation practices in European cities (Paris (France), Manchester (United Kingdom), Bratislava (Slovakia) and Bilbao (Spain)) and developed tools to guide the process of impact and vulnerability analysis for critical infrastructures and built areas.</td>
<td>This project has received funding from the European Union’s Horizon 2020 research and innovation programme.</td>
<td>The project started in 2015 and was completed in 2018</td>
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### CONTACT INFORMATION

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