Leveraging technology and innovation in disaster risk management and finance

Asia Finance Forum, Manila November 2019





Innovations and emerging technologies can address acute disaster risk management challenges in the APEC region

The Asia-Pacific region is highly vulnerable to disaster risk, with the poor affected disproportionately

- Annual average losses from disasters in APEC economies amount to \$140bn*
- Developing economies and vulnerable populations bear a disproportionate impact of disasters
- The region faces increasing risks due to development and climate change, with potential for cascading impacts

Efforts to manage risks are hampered by a lack of enabling capacity or policy framework

- Policymakers have incomplete information on risk and lack capacity
- Underdeveloped insurance markets mean risk is mis-allocated, particularly in poorer economies

Across the world, innovations and emerging technologies are being adopted to address major challenges in disaster risk management (DRM) and finance (DRF)

Our report seeks to understand the potential for technologies to overcome barriers to effective DRM and DRF in the APEC region -- and to set out an agenda for stakeholders to unlock this potential

Innovations span DRM and DRF value chains, producing potential benefits across all areas of public and private sector risk management



Earth observation technologies are increasingly applied in DRM, as a result of innovation both in the technology itself and in adjacent areas

Earth Observation (EO) technology

Established technology

Innovations

- Spatial and temporal resolution of data converging to defence needs (<30cm). Sub-metre resolution more accessible and affordable.
- Hyperspectral / LiDAR / synthetic aperture radar can assist in classifying structures
- More robust sensors mean planners can rely on technology after a disaster

Multipliers

Technological innovation

- New algorithms (incl. AI) derive risk information
- Cloud computing makes real-time analysis feasible
- Standardised and open source software more widely accessible
- EO data integrates with spatial analysis tools

Community based innovation

- EO datasets underpin risk resources (OpenStreetMap)
- 'New space' private Silicon-Valley based actors like Planet Labs driving innovation in high revisit

Applications

Real-time flood hazard mapping in Southern Africa. Provides open source decision support tools / EWS; relies on crowdsourced validation

Community mapping in urban areas in Bangladesh. Crowdsourced data on building quality and conditions for risk reduction.

High resolution Earth Observation data fused along with crowd-sourced Open Street Maps for climate-resilient urban planning in Guyana



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Artificial intelligence techniques can improve understanding of risks and acuity of forecasts, leveraging data collection and computation technologies

Artificial intelligence

Innovations

- Deep / machine learning algorithms support rapid data analysis, particularly in generating forecasts from diverse data sources
- Advances in data mining support identification of latent trends
- Natural language and image processing techniques increase the range of input data

Multipliers

Technological innovation

- Cloud computing and graphics processing units support large scale, high intensity analysis
- Earth observation and Internet of Things provide new data sources

Community based innovation

- Collaborative platforms such as GitHub
- Crowdsourcing training data
- Social media as a data source

Applications

Deep learning based approaches to poverty mapping for social vulnerability exposure to disasters in Uganda

Al-enabled assessment of building vulnerability using EO and street level images to prioritise resilience investment in Guatemala City

Detection of heavy rain disasters in Japan using data-mining of physical and 'social' sensors



The internet of things is a worldwide network of interconnected objects that can transmit information on disaster risk and assist in coordinating responses

Internet of Things (IoT)

Innovations

- Availability of new types of sensors, with increased reliability and precision. For example, sensors on smartphones (e.g. pressure sensors, proximity sensors, accelerometers)
- Interconnected smart devices interacting without human assistance
- Communication networks that provide capacity and faster communication (e.g 5G networks)

Multipliers

Technological innovation

- Earth observation data
- AI algorithms to rapidly process diverse data sources

Community based innovation

 Smart phones and social media support transmission and interpretation of data

Applications

Sensors for flood control in Colombia, equipped with solar panels and capable of sending automated warnings to village authorities

IoT mudslide protection in El Salvador, combining human and sensor input and transmitting information through a mesh radio network

Real-time landslide and flooding sensors in Rio De Janeiro



Innovative DRF mechanisms leverage data and mobile technologies to provide timely funding for protection, relief and recovery efforts

Disaster risk finance	Multipliers	Applications		
 Innovations Parametric insurance makes pay-outs contingent on realisations of risk indices, increasing rapidity of payment during time of greatest need Forecast-based finance provides pre-emptive funding on a similar basis, allowing targeted funding for preventative measures 	 Technological innovation EO, IoT, AI can define indices that reduce basis risk and facilitate timely payments Blockchain can execute transactions automatically 	ACRE bundles parametric crop insurance with seed, using local sensors and mobile payment systems for rapid payment		
	 Community based innovation Mobile payments to support rapid claim disbursement Pooling and governance structures to incentivise effective planning Social media to target recipients 	Livestock insurance in Kenya which uses parametric triggers based on grazing conditions using EO data		
		Initial work by B3i to use blockchain to settle reinsurance contracts for cat losses		
		International Institute for		

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Applied Systems Analysis

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Barriers to the adoption of novel technologies are wide ranging and call for responses across various domains of government

Enabling conditions	Infrastructure requirements	Implementation capacity	Access to data and software	User awareness and acceptance	Policy and governance barriers	Regulatory challenges
Example technologies	 Internet of things Cloud computing Social media Mobile banking 	 Decision support tools Parametric insurance and forecast based finance Delivery drones 	 Earth observation Artificial intelligence 	 Parametric insurance Visualization tools Social media 	 Innovation in government Decision support tools Parametric insurance and forecast based finance 	 Parametric insurance Data collection technologies Artificial intelligence
Solutions	 Network connectivity Smartphone penetration 	 Knowledge transfer schemes Technical training for policy makers 	 Local data collection and sharing; open source platforms; technology transfer agreements 	 Awareness and digital literacy campaigns; pilot schemes 	 Innovation incentives Demonstrators Effective coordination and stable funding regimes 	 Comprehensive risk-based regulation on privacy, finance, consumer protection, discrimination soft-law mechanisms



Action by policy makers can promote the successful adoption of technologies

National interventions to promote innovation directly

- make innovation a distinct DRM policy goal, with appropriate oversight
 - ♦ 'Chief Technology Officer' role in disaster agencies
- provide incentives and structures for innovation to take root
 - ♦ incubators or seed funding for demonstration projects

National interventions to create enabling conditions for innovation in DRM / DRF

- support infrastructure delivery, with a particular focus on connectivity for vulnerable regions / groups
- training for DRM / DRF professionals on use of sophisticated risk information
- conduct awareness / educational campaigns for users particularly financial literacy
- develop regulations and enforcement of data security to engender public trust
- update financial regulatory frameworks to allow for innovation in insurance products, with effective consumer protection

Interventions by international organisations

- establish platforms to transfer knowledge
- identify synergies in DRM/DRF activities across regions and build common solutions



