



**Asia-Pacific
Economic Cooperation**

2019/FDM2/012
Agenda Item: 4.3

Leveraging Technology and Innovation for Disaster Risk Management and Financing: A Note to APEC Finance Ministers on Initial Findings

Purpose: Information
Submitted by: ADB, OECD



**Finance and Central Bank Deputies' Meeting
Santiago, Chile
13 October 2019**



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October 2019

Introduction

Disaster and climate risks pose a significant threat across the Asia-Pacific region given the high-level of vulnerability and exposure to a wide range of natural hazards. A changing climate, continued economic development and population growth are expected to increase the frequency and severity of disasters and the resulting damages and losses across the region posing a significant threat to socio-economic development and undermining hard-won development gains. Technological developments and innovation offer opportunities to improve the management of disaster and climate risks (before, during and in the aftermath of disasters) and enhance the availability and affordability of financial protection tools, such as insurance.

In recognition of the importance of these risks, APEC Finance Ministers agreed in the [Cebu Action Plan](#) to enhance financial resilience against economic shocks, including by “developing innovative disaster risk financing and insurance mechanisms (including micro-insurance) to enable APEC economies exposed to natural hazards to increase their financial response to disasters and reduce their fiscal burden”.

In accordance with the APEC 2019 Finance Ministers’ Process Work Plan, the Asian Development Bank (ADB) and the Organisation for Economic Cooperation and Development (OECD) are collaborating on the development of a report for APEC Finance Ministers’ examining how emerging technologies and innovation can be leveraged to improve disaster risk management and financing. The objective of this report will be to identify opportunities to unlock the potential of emerging technologies and innovations in APEC member economies and contribute to APEC Finance Ministers’ efforts to enhance financial resilience against disaster risks.

This note¹ provides an overview of the initial findings from that work. A final report, which will incorporate the outcomes of discussions at the High-Level Seminar on Enhancing Financial Management against Natural Disasters in Santiago on 14 October and a policy dialogue to be held at the Asian Development Bank in Manila in November, will be submitted to APEC Finance Ministers under Malaysia’s APEC Presidency in 2020.

APEC economies are significantly exposed to disaster risks

Since 2000, APEC economies have faced approximately USD 2.6 trillion in economic losses and 480 000 fatalities as a result of significant natural hazard events, accounting for more than 40% of all victims and over 80% of economic losses reported globally.² APEC economies have faced 8 of the 10 costliest earthquakes since 2000 and 7 of the 10 costliest floods. In many APEC economies – and particularly in developing economies – low levels of insurance coverage mean that most of these losses and a significant share of the costs of recovery and reconstruction are borne by households, businesses and governments.

As extreme events become more frequent and severe and as assets accumulate in hazard-prone areas, the social, economic and financial impacts of natural hazards are expected to increase. Disaster and climate risks constitute one of the most significant threats to socio-economic development and often affect the poorest segments of the population disproportionately - destroying the homes and livelihoods of those that do not possess the savings or financial assets necessary to recover.³ One recent analysis suggests

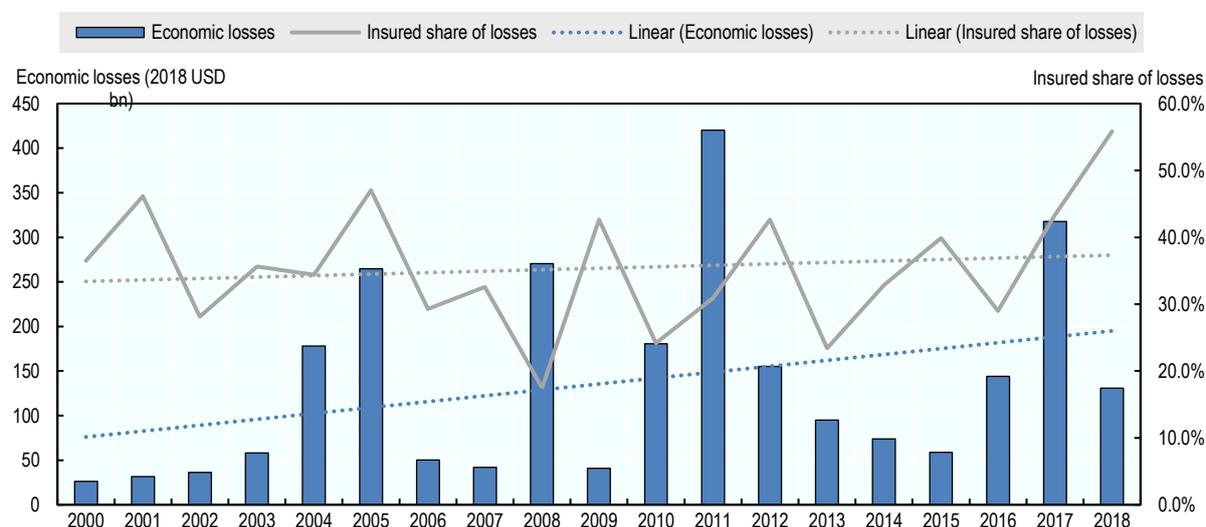
¹ This note has been developed by the ADB and OECD, based on input provided by Vivid Economics and the International Institute for Applied Systems Analysis (IIASA).

² OECD calculations based on Swiss Re *sigma* data (2000-2018).

³ *Asian Development Outlook 2019*, Asian Development Bank, <https://www.adb.org/publications/asian-development-outlook-2019-strengthening-disaster-resilience>.

that damages and losses resulting from natural hazards could undermine economic growth and poverty reduction in the region.⁴

Figure 1. Economic and insured losses: APEC economies



Source: OECD calculations based on Swiss Re *sigma* data

Managing the social, economic and financial impacts of natural hazards presents a complex policy challenge for governments. Inadequate levels of risk awareness, insufficient integration of risk into strategic planning and investment decisions and limited resources for investing in disaster risk reduction, emergency preparedness and response amplify the impacts of natural hazard events.

Emerging technologies and innovation present opportunities to improve disaster risk management and financing

The application of emerging technologies and related innovations can make an important contribution to improving disaster risk management and enhancing the availability and affordability of financial protection by providing:

- **New sources of data** such as the data available from earth observation sources, connected devices (“internet of things”) and social media (“crowdsourcing”) can provide more granular information on exposure and vulnerability and more timely information on losses and damages. High and very-high resolution earth observation imagery is increasingly available at a greater frequency and can be combined with OpenStreetMap and other sources of exposure data to provide detailed assessments of risk, even in regions that have faced historical gaps in data coverage. International initiatives, such as the European Space Agency’s Earth Observation for Sustainable Development programme, are increasingly providing access to earth observation data and the tools to integrate that data into planning decisions and post-disaster reconstruction. Connected devices allow for real-time monitoring of potential hazards such as floodwater levels. For example, in Rio de Janeiro, a network of connected sensors covering weather, traffic, police

⁴ *Asia-Pacific Disaster Report 2019*, United Nations Economic and Social Commission for Asia and the Pacific, <https://www.unescap.org/publications/asia-pacific-disaster-report-2019>.

and medical services is used to monitor disaster risk in real time and has enabled a reduction in emergency response times and improved coordination and communication among public agencies. Crowdsourcing has enabled volunteer teams to make detailed maps rapidly, gathering information to build on what is available through satellite imagery. For example, Twitter posts are used in Indonesia and Japan to rapidly detect heavy rain events.

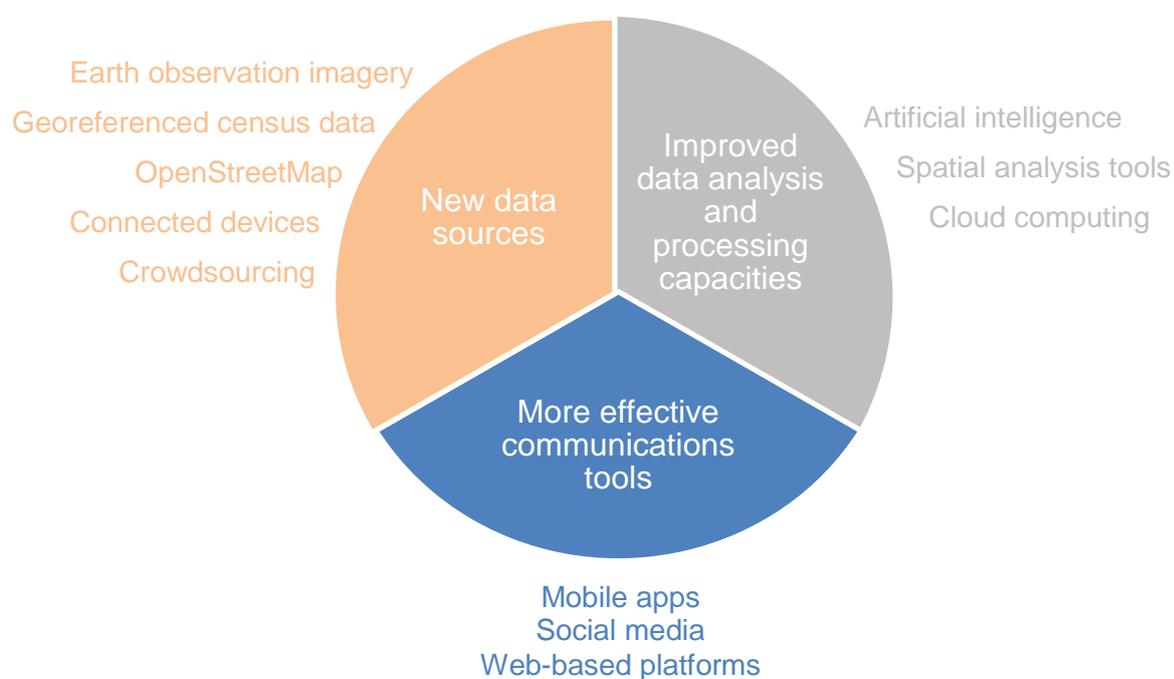
- **Improved data analysis and processing capacities** such as artificial intelligence/machine learning, cloud computing and spatial analysis tools provide enhanced capacities to utilise data from different sources. Spatial analysis tools such as Geographic Information Systems (GIS) facilitate the integration of earth observation data into risk assessment and planning decisions. Cloud computing offers increased computational capacity to run complex risk or impact models and enables cooperation between geographically dispersed decision makers. Artificial intelligence and machine learning capabilities allow for the processing of data for the identification of trends and causal factors. For example, artificial intelligence has been successfully used in Guatemala City to identify homes at risk of collapse during an earthquake and is being applied by the US National Aeronautics and Space Administration to estimate landslide risk. In Japan, new artificial intelligence-based approaches to assessing tsunami and river flood risks have been developed for implementation in the coming months.
- **More effective communication tools** such as mobile apps, social media and web-based platforms can support faster and more accessible dissemination of risk and impact information and mitigation and preparedness advice, allowing for more effective knowledge sharing and decision-making. For example, following the 2015 floods in Chennai, (India), dedicated Twitter handles were established to source information on people willing to volunteer and those needing rescue and assistance, and facilitated the development and dissemination of information on shelter and weather patterns.⁵ The Government of Sri Lanka has launched a 'National Disaster Risk Platform' to consolidate data from various sources and facilitate the sharing of geospatial datasets in a collaborative multi-agency environment.

Box 1. The application of emerging technologies to financial protection products

Enhanced data collection, analytical capacity and communication tools are having a particular impact in the insurance sector. Earth observation and connected device data are being used to underwrite insurance coverage more efficiently, while artificial intelligence is being applied to settle claims. Products are being developed based on the availability of specific data sources, such as parametric insurance products that are underwritten and pay-out based solely on observable physical parameters. Digital channels, such as mobile apps, are being used to distribute insurance coverage and settle claims in the event of a loss. Blockchain solutions offer an opportunity to automate some insurance processes through the use of smart contracts. These developments have the potential to increase the availability – and lower the cost – of financial protection against disaster and climate risks.

⁵ *Disruptive technologies and their use in disaster risk reduction and management*, International Telecommunication Union, https://www.itu.int/en/ITU-D/Emergency-Telecommunications/Documents/2019/GET_2019/Disruptive-Technologies.pdf.

Figure 2. Emerging technologies with DRM/DRF applications



Source: OECD, adapted from Vivid Economics

Identifying emerging technologies with potential benefits for disaster risk management and financing

An initial assessment of these emerging technologies, based on their application to disaster risk management challenges, suggests a number of technologies and innovations that can help improve disaster risk management and the availability of financial protection (see Table 1). Many of these technologies, including OpenStreetMap, earth observation data, crowdsourcing of information and spatial analysis tools, pose relatively few implementation challenges in the APEC region as the underlying technology is well-developed and tested, and the risk of failure due to external factors is manageable. The application of other emerging technologies, such as artificial intelligence and machine learning, presents more significant challenges as a result of issues such as the availability of the necessary technical skills, consumer acceptance and trust issues and/or the lack of an enabling regulatory framework.

Table 1. Applications and implementation challenges of emerging technologies

Technology	Potential applications in disaster risk management and financing	Examples of existing use	Implementation challenges
OpenStreetMap	Open and freely available global dataset of geographic and infrastructure data that can be used to inform disaster risk assessments, optimise land use and spatial planning and assess damage.	Community mapping (Bangladesh)	Few – some remaining concerns about data accuracy
Earth observation data	Information on the physical, chemical and biological systems of the planet, collected through satellite or aircraft imagery, which can be used to inform disaster risk assessments, optimise land use and spatial planning and assess damage.	Earthquake vulnerability (Guatemala) Livestock Insurance (Kenya) Earth Observation for Sustainable Development (global)	Few –use of drones could create air traffic risks
Crowdsourcing of information	Collection of real-time localised information from social media, crowd sensing or collaborative mapping which can be used in disaster risk assessment, early warning and preparedness and for damage assessment.	Community mapping (Bangladesh) Heavy precipitation analysis (Japan) Hurricane Maria response (Puerto Rico)	Few – potential for inaccurate or biased information
Spatial analysis tools	Software that enables the identification of trends and patterns in spatial data which can be applied to disaster risk assessment, optimisation of land use and spatial planning, rescue and relief operations, aid delivery and damage assessment.	Heavy precipitation analysis (Japan) Landslide Hazard Assessment (United States)	Few – requires some technical skills to apply
Artificial intelligence (AI)	The ability of a machine to process images and natural language and learn from analysing data. AI has the potential to significantly increase the speed and accuracy of decision-making and operations with wide-ranging applications in disaster risk assessment, land use and spatial planning, preparedness and early warning, damage assessment and the underwriting, design and distribution of financial protection.	Heavy precipitation, tsunami and river flooding analyses and assessments (Japan) Earthquake vulnerability assessments (Guatemala) Landslide Hazard Assessment (United States)	Some - requires technical expertise to design and implement the algorithms and interpret outputs – risk of bias

Source: OECD (adapted from Vivid Economics)

Establishing an enabling environment that supports technology adoption and integration

The successful application of emerging technologies to disaster risk management and financing will require efforts to create an enabling environment, particularly in five key areas:

- **Resilient and continuously improving telecommunications infrastructure:** Telecommunications infrastructure, mobile internet coverage and smartphone penetration are necessary pre-conditions for the application of many of these emerging technologies. Incentives to support wireless network deployment and programmes to support access to smartphones can therefore play an important supporting role in the deployment of technology for disaster risk management and financing.
- **Technical skills and capability:** Many emerging technologies, including the application of artificial intelligence and spatial analysis tools, and the development of parametric insurance products and blockchain solutions, require high levels of expertise in these technologies. Knowledge sharing

platforms and partnerships, including international academic partnerships and (re)insurance sector relationships, could support the education and development of expertise in these areas.

- **Access to data and software:** Data analysis and processing technologies rely on the availability of high-quality datasets and an increasing amount of the needed data is made freely available and/or provided through open-source platforms.
- **User awareness and acceptance:** The effective integration of new communication tools and the distribution of new types of insurance products is dependent on awareness and acceptance among target audiences. Widespread adoption of these technologies can be facilitated by digital literacy programmes and public information campaigns.
- **Regulatory adaptation:** Regulatory frameworks across a variety of domains will need to be established or adapted to support the adoption of emerging technologies.

To achieve these potential benefits, the integration of new data and processing technologies and communications tools into disaster risk management and financial protection must be managed carefully. An increased reliance on telecommunications infrastructure in disaster response and recovery will require efforts to ensure that capacity is expanding in tandem with the applicable technologies, that networks are disaster resilient and that the use of emerging technologies does not exclude more vulnerable or marginalised segments of society – as well as a back-up plan should the technology fail.

Open access to new data and processing technologies creates significant benefits but there is also a need to ensure that the policy framework for intellectual property protection provides sufficient economic incentives to encourage the development of new data sources and processing technologies. Regulatory frameworks protecting privacy and financial sector consumers need to be adapted so that innovation and the use of new data and processing technologies is encouraged, while ensuring sufficient consumer protection against the misuse of their data, biased outcomes and unsuitable products.

Box 2. Leveraging emerging technologies: some initial policy options

Promoting and supporting the application of emerging technologies and innovation as a policy goal in disaster risk management and financing by:

- identifying innovation as a distinct objective of national disaster risk management and financing strategies, possibly overseen by a ‘Chief Technology Officer’ or an Advisory Board composed of scientists and academics and supported by partnerships with research centres;
- offering specific funding for innovation through the establishment and funding of incubators targeted at the integration of new technologies and/or offering seed funding for pilot projects;
- funding training and partnerships to build local capacity amongst not only policymakers and regulators, but also for the local industry, including through domestic research centres and universities and by implementing formal knowledge-sharing platforms across jurisdictions; and
- supporting education and awareness campaigns for users of technology and financial services to raise public awareness of disaster risks, disseminate best practices and tools that reduce vulnerability and exposure, and improve financial and insurance literacy.

Adapting regulatory frameworks for a digital environment by:

- Establishing or adapting regulatory frameworks on the permissible use of data that provide sufficient privacy protection (accounting for potential differences in societal preferences for data protection), while also allowing for the use of data in disaster risk management and financing;

- Adapting insurance (and potentially other financial sector) regulatory frameworks to allow for the development and dissemination of innovative financial protection products (such as parametric or index-based insurance) and to create appropriate incentives for disaster risk reduction activities and knowledge-sharing partnerships within the insurance sector – while maintaining public trust in financial protection products and providers.