Featured event

Emerging Technologies and Innovation

11:30 – 12:45

Wednesday, 20th March 2019

Taj Mahal Hotel, New Delhi

The Panel

Speakers – Digital Technologies

- Seema Kumar, IBM (Chair)
- Andre Cuomo, Sacertis
- Mark Polyak, IPSOS
- Dr. Sushil Gupta, Assistant Vice-President, Risk Modelling & Insurance, RMSI
- Air Asia Survey*

Speakers – Engineering and Nature Based Solutions

- China
- Netherlands
- Prof. Mauro Dolce, Dipartimento della Protezione Civile, Italy
- Aslam Perwaiz, Asian Disaster Preparedness Centre (ADPC)
- Saramap, Switzerland
- Dr K. Satyagopal, Tamil Nadu

Session Format

This session will comprise two parallel sessions. Each will have presentations by speakers of 7 minutes each followed by a joint moderated panel discussion.

Overview

Digital Technologies

Increasing digital coverage, dropping costs and rapid rate of innovation is enabling a transformation from analog to digital disaster risk management. In the last three decades, every year, bandwidth cost has reduced by 20%, computing cost by 33%, data storage cost by 37% and mobile services cost by 3%. Across the four stages of preparedness, response, recovery and mitigation, use of emerging technologies like Artificial intelligence (AI), Internet of Things (IoT), Block-chain are revolutionizing the way disaster managers and decision makers acquire, analyse and act on the data. Use of emerging technologies is critical to an efficient, scalable and cost-effective resilience building of current and future infrastructure assets.

1. **Remote sensing + Machine Learning + Cloud Computing**

Hazard and extreme event warnings and advisories play a critical role in determining the extent of preparedness and impact of extreme events on populations, infrastructure, livelihoods and economies. Remote sensing technologies can collect panel data at low marginal cost, repeatedly, and at large scale on proxies for a wide range of hard-to-measure characteristics. As improved satellite imagery becomes available, new remote-sensing methods and machine-learning approaches have been developed to convert terrestrial earth-observation data into meaningful information about the vulnerability of populations, infrastructure and other assets. Artificial intelligence (AI) and data science technologies, specifically machine learning and data mining, bridge the gap between numerical model prediction and real-time guidance by improving accuracy. They can be used to enhance the accuracy of parametric weather information, timeliness and location-specific early warnings and make simulations more useful for decision-makers. Combination of satellite imagery, machine learning and surface modelling is also being used for structural vulnerability and impact assessments and monitor progress of reconstruction. For example, combining high definition satellite imagery with 3D surface models allows immediate recognition of structural deficiencies, oblique-level of damage assessment, and ability to run automated change detection to identify increase in infrastructure density, abnormality in structures, etc. Until recently, expensive satellite imagery and limited computational power only allowed analysis of small geographical areas. Cloud-based computational platforms are becoming increasingly accessible and allow one to scale analysis across space and time. Publicly available satellite data (e.g.

Landsat and Sentinel) is now brought to the cloud and using machine learning algorithms analysed in various cloud-based platforms.

2. **Internet of Things (IoT) - Sensors + Cloud Computing**

Over the last two decades, infrastructure assets have increased at an exponential pace, and so have the number of potential assets at risk. The development of sensor-based technologies has greatly improved information collection, data transmission and processing, which can serve as the foundation of the modernization of resilient infrastructure construction management. The IoT leverages heterogeneity, interoperability, distributed processing, and real-time analytics in parallel. Structural health monitoring (SHM) is critical to identify the vulnerability and risks early on and monitoring the key parameters such as temperature, deformation, stress and displacement acceleration, displacement and strains on the structure is a key part of it. IoT or sensors and wireless sensor networks (WSN) play an important role in structural health monitoring. For example, temperature sensors embedded in concrete can record the concrete hardening process in an early phase, which has been used to evaluate the quality, compressive strength and flatness of concrete; optical-fibre sensors embedded in concrete have been applied to monitor the strain and cracks of structures. In recent years, WSN has been widely utilized in structural health monitoring of bridges, dams and other critical infrastructure.

WSNs are also widely deployed in other areas of disaster management. For example, IoT is being used for landslide monitoring in Uttarakhand and Kerala in India, where deployment of tilt sensor, pressure sensor, moisture sensor, geophone, and strain gauge sensors were deployed to monitor rain fall induced landslides. IoT-enabled beacons are designed to notify its user about possible earthquake or tsunami in personal-aware mode, makes alarming sound and sending push notifications to user smart phones instantly. For floods, open crowd-sensing IoT-enabled infrastructure is connected to flood sensing nodes around the globe is usually deployed under the river bridge, measures the water level and transmits on map networks. If water-level exceeds the predetermined safety level, the map changes colours. To enable rapid disaster response, pre-deployed sensors can easily broadcast signals and communicate critical data such as temperature, water quality, or smoke to help government can make more informed decision on how to deploy resources during a disaster situation.

3. **Drones + Machine Learning**

Plummeting acquisition and operational costs, lower operational risks, higher quality data and increasing ease in regulations have made drones a popular tool for extensive data collection, detailed mapping, as well as regular inspections of infrastructure projects, especially in remote and disaster vulnerable areas. In resilient housing for example, identifying which homes face the greatest hazard risk and their exact location is critical information for government officials deciding which household should receive a subsidy or upgrade/package. This technology can now be leveraged to inform infrastructure policy design and implementation in a timely manner. High-resolution drone imagery, combined with street imagery and machine learning, along with disaster vulnerability maps, helps build an infrastructure profile that can identify which assets are safe, which can be made safer at reasonable costs, and which need to be relocated or dismantled. In post-disaster scenarios, drone overflights can employ both optical and LiDAR sensors to provide aerial imagery at 8-12 cm resolution as well as 3D imagery. Deep machine learning models can be used to process to compare the drone imagery taken pre and post events to identify the infrastructures which are damaged due to extreme events and geo-tag them automatically to communicate the damaged infrastructure location to the concerned officials.

4. **Blockchain**

Blockchain is a type of distributed ledger technology (DLT) that creates a transparent, secure, immutable, and verifiable database which does not need a central administrator to update and maintain it. Application of Blockchain technology can bring transparency, verifiability, security and immutability to disaster risk management.

Blockchain-enabled technology is for example, being used to reimagine how electricity is distributed. If and when power lines go down during a disaster, the electricity connection is broken, resulting in region-wide blackouts. Blockchains can help create and manage a grid so that electricity could be bought, sold, and traded locally (i.e. directly between nearby batteries and consumers), thereby spreading out the risk and drastically increase community resilience. Blockchain platforms can be embedded with peer-to-peer smart contracts, allowing anyone with a solar panel, generator, battery, and the ability to put electricity back on the grid — to sell electricity directly to nearby consumers without going through a distribution centre. Hence, when a disaster knocks off the power line, a decentralized grid could completely disconnect from the central system and operate in ‘island-mode’ for days, weeks — or potentially indefinitely.

Blockchain technology can seamlessly secure the vast amounts of information created by the IoT sensors. Because the information sent is unable to be changed or redirected, potential threats to the infrastructure are decreased drastically. Blockchain use-cases are also emerging in reconstruction of resilient infrastructure and housing where it is being used for aspects like land and asset titling verification, keeping track of permits, materials and contracts, reconstruction grant payments, etc.

Nature-based Solutions (NBS)

Nature-based solutions are inspired and supported by nature and simultaneously provide environmental, social, cultural and economic benefits. Nature-based solutions, such as well-connected green and blue infrastructure, green and unsealed surfaces in cities, green roofs, natural water retention measures, and salt marshes and dunes for coastal protection, use the properties and functions of ecosystems to provide water regulation, flood risk protection, climate change adaptation, etc. They are designed to bring more nature and natural features and processes into cities, landscapes and seascapes, through locally adapted and systemic interventions. They are locally attuned, resource efficient, multi-purpose, multi-functional and multi-beneficial. These key features of nature-based solutions make them different from 'grey' infrastructure, such as artificial river banks, dikes, etc. Robust evidence of the cost-effectiveness and longer-term social, economic, cultural and ecological benefits of these solutions is currently lacking and this has prevented their wider deployment.

Nature-based solutions that strategically conserve or restore nature to support conventionally built infrastructure systems can reduce disaster risk and produce more resilient and lower-cost services in developing countries. In the disaster risk management and water security sectors, NBS can be applied as green infrastructure strategies that work in harmony with grey infrastructure systems. NBS can also support community well-being, generate benefits for the environment, and make progress on the Sustainable Development Goals (SDGs) in ways that grey infrastructure systems alone cannot. Though NBS approaches have yet to be fully integrated into decision-making or to compel widespread investment in developing countries, this is on the brink of change.

Developing countries and their partners (including multilateral development banks and bilateral agencies) are increasingly utilizing NBS in DRM, as well as in water security, urban sustainability, and other development projects. The growing number of NBS projects offer lessons and insights to help mainstream NBS into development decision making. As more disaster risk managers understand and integrate well-designed NBS into DRM projects, more finance can be routed to nature-based projects that are cost-effective and resilient.

Both panels will address the following issues:

1. **On cost:** Monitoring the vulnerability or structural health of critical infrastructure such as roads, bridges, etc. is an expensive affair, especially with the sensor and monitoring ecosystem to be put in place. This can even make it prohibitive. What are the factors that can bring the costs down; is it scale, cheaper sensors, or are there newer, more affordable technologies in the making? (Examples from some key infrastructure sectors: e.g. water, irrigation, power)
2. **On technology:** What are some emerging technologies that can ensure that disruptions in services provided by critical infrastructure can be minimized? What are some of the enabling conditions for ensuring the most optimal utilization of such technologies for investing in disaster resilient infrastructure?
3. **On policy:** Are there any policy roadblocks that are preventing the full harnessing of the myriad technologies out there? What may be the enabling policies that need to put in place to attract more innovation, low-cost interventions in the space of DRM and enable translation of new technologies into practical frameworks?
4. **On scaling up:** How can technology be used to in better informing decision makers and communities to prepare for disasters. What can be done to scale up the use of tech across the country, especially in disaster vulnerable states?
5. **On Data:** What are the technical gaps (for e.g. gaps in data architecture, data formats) that are hampering development and adoption of emerging technologies?
6. **On improving capacities:** What technological innovations are being made in the area of improving “capacity development” along the four thematic pillars of CDRI?
