Geo-led Horizon Scanning Programme for Disaster Risk Reduction (DRR): A New Insight into 2030 Global Vision

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OUTLINES

Disasters at Glance (Global, Asia, ASEAN) I Concept of Horizon Scanning
Sendai VS SDG I Transdisciplinary Approach I Case Studies I Concluding remarks
MULTI-GEOHAZARD & DISASTER RISK
A TRANSDISCIPLINARY DISASTER RESEARCH

Advancing disaster risk reduction in a changing environment

“Knowing Our Current Risk, Preventing Our Future Risk”

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Disaster Risk Reduction and Management

Advancing science and technology for disaster risk reduction and management
Supporting evidence-based decision making for reducing future disaster risk
Promoting Transdisciplinary Approach (TDA) for building societal resilience
Disaster Risk Reduction and Management

MULTI-HAZARD RISK ASSESSMENT, MAPPING, MONITORING, EARLY WARNING-BASED IMPACT AND PREDICTIVE MODELLING

DATA MANAGEMENT & ANALYTICS   DECISION MAKING

ASEAN Vision 2025 on Disaster Management
Sendai Framework for Disaster Risk Reduction 2015-2030
Paris Agreement on Climate Change
New Urban Agenda
Agenda 2030 for Sustainable Development
Numbers of disasters per type, 1998-2017

Source: CRED & UNISDR, Economic Losses, Poverty and Disasters 1998-2017
Number of people affected and numbers of death per disaster type, 1998-2017

Affected people:
- 45% (2.0 billion) Flood
- 16% (726 million) Storm
- 13% (126 million) Earthquake
- 7.8% (563 million) Extreme temperature
- 5.6% (405 million) Landslide
- 5.2% (378 million) Drought
- 4.8% (347 million) Wildfire
- 3.5% (254 million) Volcanic activity
- 1.4% (99 million) Mass movement (dry)

Death:
- 56% (747,234 deaths) Flood
- 17% (232,680 deaths) Storm
- 11% (166,346 deaths) Earthquake
- 10% (142,088 deaths) Extreme temperature
- 2% (21,563 deaths) Landslide
- 1% (18,414 deaths) Drought
- 0.2% (4,8 million) Wildfire
- 0.1% (6.2 million) Volcanic activity
- 0.1% (2.398 million) Mass movement (dry)

Source: CRED & UNISDR, Economic Losses, Poverty and Disasters 1998-2017
Annual affected populations by national income bracket, 1998-2017

Source: CRED & UNISDR, Economic Losses, Poverty and Disasters 1998-2017
Climate-related and geophysical disasters, 1998-2017

Source: CRED & UNISDR, Economic Losses, Poverty and Disasters 1998-2017
Human and economic costs of geophysical disasters, 1998-2017

Economic losses to disasters in Asia and the Pacific could exceed $160 billion annually by 2030 (UN ESCAP, 2018)

Source: CRED & UNISDR, Economic Losses, Poverty and Disasters 1998-2017
FIG Working Week 2019, 22-26 April 2019 @ Hanoi, Vietnam
Geo-led Horizon Scanning Programme for Disaster Risk Reduction (DRR):
A New Insight into 2030 Global Vision
In 2018, the combined **nominal GDP** of Southeast Asian countries **ranked fifth globally**, amounting to **USD 2.89 trillion**. However, due to the constant risk of natural hazards, the region’s exposed **capital stocks** amount to **USD 8.35 trillion**, or **THREE TIMES OF ITS COMBINED ECONOMY** (Pang & Dimailig, 2019)

Indonesia (63%) I Philippines (10%) I The rest (27%)
Percentage of Population Exposed to Floods in ASEAN Member States

Distribution of Disasters in ASEAN (July 2012-January 2019)

Flood (56.55%)
As core development strategies, **10 of the 17 SDGs with 25 targets** are identified related to **disaster risk reduction (DRR)**. Given extreme climate and rapid urbanization, it is crucial for us to better cope the disaster capacity, assessing our increased exposure to natural hazards and advancing our understanding disaster by science and technology.
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Horizon scanning is the intelligence gathering part of strategic foresight, concerned with emerging trends, issues and uncertainties that the future may bring, and assessing their potential impact.
Horizon Scanning can be a good technique for people to look at complexity, challenge assumptions and review multiple ways that events could unfurl, in order to increase the resilience and reliability of their organisations.

It is not about trying to predict the future but rather to review options so that evidence-based decisions can be made (Institute of Risk Management, 2017)
Horizon scanning assesses the information available about future trends and explores the range of potential futures that may result. Using this analysis helps policy makers to get a richer, more informed view about the future, and build that into their plans.

Current & new disaster risk in future
Policy-makers & disaster managers
Risk-informed decision making
Transdisciplinary Approach (TDA)

“An approach to achieve a common societal goal, by all players and stakeholders at all levels of all related disciplines (natural, social and humanity sciences) and sectors (public, private, academia, and civil) working together, going beyond the limit of disciplinary knowledge and sectoral capacities by creating innovation means, and making holistic and transformative solutions possible”

Scientific knowledge-based decision making

Co-Design, Co-Produce, Co-Deliver, and Co-Implement

Societal Transformation is only possible by TDA

Master of Disaster Risk Management (MDRM) http://mjiit.utm.my/dppc/mdrm-homepage/
Stakeholders

- Villagers
- Head of communities
- Children & Youth
- Elders
- People with disabilities
- Teacher
- Public Officers
- Immigrants
- Refugees
- Others

- Local/state agencies
- Federal/central agencies
- Ministry of Health & its agencies
- Ministry of Education & its agencies
- Districts officers
- Police, Fire, Army departments
- Public Healthcare providers- clinic, hospitals

- Small Medium Enterprises
- Government-linked companies (GLCs)
- Financial Institutions
- Public & private early learning centers
- Public & private higher education institutions
New Approach: Multi-Hazard & Disaster Risk Management

Three main components:

1) Technical assessment (hazard and risk)
2) Decision making (use cases)
3) Data management
BIG DATA PLATFORM FOR DISASTER RISK REDUCTION - CONCEPT

Telemetry Data Sources
- GIS (e.g., Maps, Regional Details, Location Details, Mining Details)
- Sensors (e.g., Temp., Environment, Weather, Moisture, Humidity)
- Social Media (e.g., Facebook, Twitter, Telegram)
- Satellite (e.g., GPS, Landsat, SRTM)

Telemetry Data Collectors
- Sensors Ingest Probes
- Social Media API
- Satellite Ingest Probes

REAL-TIME PROCESSING DISASTER RISK ANALYSIS ENGINE

Processing Pipeline
- Telemetry Parsers
- Enrichment
- Alert Triage
- Recommendation Engine

Data Operating System (YARN)
- Map Reduce
- Pig
- Hive
- H-Base
- Solr
- Spark

Hadoop Distributed File System (HDFS)

Security & Operations

Modules
- Real-Time Search
- Evidentiary Store
- Disaster Risk Monitoring Dashboard
- Ad hoc Query
- Statistical Analysis

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Hazard & Risk Data Management

Inventories
- Hazard Inventories
  - Flooding
  - Landslides

Susceptibility / Hazard
- Factor Maps
  - Geomorphological
  - Geological
  - Anthropogenic
  - Hydrology
- Triggering factors
  - Rainfall
  - Earthquake

Element at Risk
- Vulnerability
  - Physical, Social, Economy, Environment

Risk & Loss
- Quantitative & Qualitative

3D City Modeling for Disaster

Storage of 3D City Models
- Multi-scale database
- Data structure & exchange format
- CityGML

Construction of 3D City Models
- Level of Detail (LOD)
- GIS/CAD/BIM data
- Building Reconstruction

Visualization of 3D City Models
- Real-Time Rendering of 3D City Models
- Service-Based Rendering of 3D City Models
- Map-Based Visualization

Technical Assessment

Hazard analysis
- Multi-hazard assessment
- Hydrological & hydraulic modeling

Multi-hazard assessment
- Statistical & physically based modeling & run out modeling

Risk Analysis
- Risk information: economic losses
  - Population losses
- Single hazard
  - Multi-hazard
- Quantitative
  - Qualitative

Loss estimation
- Exposure analysis
- Vulnerability Assessment
- Economic losses
  - Population losses

Risk Communication
- enable real time information through the use of social media platforms.
- be a helpful means in reaching out to particular demographic groups.
- provide messages that are culturally adapted to different local settings

Decision Making

Risk Evaluation & Reduction Alternative
- Structural mitigation
  - Early warning
- Non-structural mitigation
  - Land use planning

Stakeholder
- Objective
- Scale
- Legal framework
- Sectors

Multi-Criteria Evaluation
- Indicators & Weights

Cost-Benefit Analysis
- Qualitative & Quantitative

Future trends
- Climate change
- Land use change
- Population change
A: Input data
B: Susceptibility assessment
C: Hazard assessment
D: Exposure analysis
E: Vulnerability assessment
F: Risk assessment
G: Quantitative risk
  - Economic risk
  - Direct
  - Indirect
  - Population risk
  - Societal risk
  - Individual risk
H: Qualitative risk
I: Risk reduction measures
<table>
<thead>
<tr>
<th>Type of elements at risk</th>
<th>Small</th>
<th>Medium</th>
<th>Large</th>
<th>Detailed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buildings</td>
<td>By Municipality - Nr. buildings</td>
<td>Mapping units - Predominant land use - Nr. buildings</td>
<td>Building footprints - Generalized use - Height - Building types</td>
<td>Building footprints - Detailed use - Height - Building types - Construction type - Quality / Age - Foundation</td>
</tr>
<tr>
<td>Transportation networks</td>
<td>General location of transportation networks</td>
<td>Road &amp; railway networks, with general traffic density information</td>
<td>All transportation networks with detailed classification, including viaducts etc. &amp; traffic data</td>
<td>All transportation networks with detailed engineering works &amp; detailed dynamic traffic data</td>
</tr>
<tr>
<td>Essential facilities</td>
<td>By Municipality - Number of essential facilities</td>
<td>As points - General characterization - Buildings as groups</td>
<td>Individual building footprints - Normal characterization - Buildings as groups</td>
<td>Individual building footprints - Detailed characterization - Each building separately</td>
</tr>
<tr>
<td>Population data</td>
<td>By Municipality - Population density - Gender - Age</td>
<td>By ward - Population density - Gender - Age</td>
<td>By Mapping unit - Population density - Daytime/Nighttime - Gender - Age</td>
<td>People per building - Daytime/Nighttime - Gender - Age - Education</td>
</tr>
<tr>
<td>Agriculture data</td>
<td>By Municipality - Crop types - Yield information</td>
<td>By homogeneous unit - Crop types - Yield information</td>
<td>By cadastral parcel - Crop types - Crop rotation - Yield information - Agricultural buildings</td>
<td>By cadastral parcel, for a given period of the year - Crop types - Crop rotation &amp; time - Yield information</td>
</tr>
<tr>
<td>Economic data</td>
<td>By region - Economic production - Import / export - Type of economic activities</td>
<td>By Municipality - Economic production - Import / export - Type of economic activities</td>
<td>By Mapping unit - Employment rate - Socio-economic level - Main income types - Plus larger scale data</td>
<td>By building - Employment - Income - Type of business - Plus larger scale data</td>
</tr>
<tr>
<td>Ecological data</td>
<td>Natural protected areas with international approval</td>
<td>Natural protected area with national relevance</td>
<td>General flora and fauna data per cadastral parcel</td>
<td>Detailed flora and fauna data per cadastral parcel</td>
</tr>
</tbody>
</table>
An Integrated Research Framework
“Disaster Resilience Model”

\[ R = f(D, A, T) \]

Where
R: Resilience; D: Damage = f(H, E, V); A: Human Activities; T: Time

where D = f(H, E, V)

\[ R = f(H, E, V, A, T) \]

Prevention Recovery
How to mainstreaming Disaster Risk Reduction (DRR) into development planning?

Roles and contribution of surveyors into DRR world?
Kundasang (Ranau, Sabah) – home to UNESCO’s World Heritage Site in Malaysia
– Most tectonically active region in Malaysia, most attractive to tourism, community-at-risk
SEISMIC ACTIVITIES (1976 – 2015)
More bodies found on Malaysia mountain as quake toll hits 13

KUALA LUMPUR, Malaysia (AP) — Rescuers recovered the bodies of 11 more climbers from Malaysia's highest peak on Saturday, a day after it was struck by a strong earthquake, bringing the total number of dead to 13.

Six people remained missing on 4,095-meter (13,435-foot) Mount Kinabalu in eastern Sabah state on Borneo, where a magnitude-5.9 earthquake on Friday sent rocks and boulders raining down the trekking routes, trapping dozens of climbers.

"This is a very sad day for Kinabalu," said Sabah's tourism minister, Masidi Manjun.

5.9 magnitude earthquake hits Sabah (Updated)

Australian climber stranded after Malaysia earthquake slams rescue effort

An Australian climber has savaged Malaysian authorities following Borneo earthquake that killed 13 people when it jolted south-east Asia's highest peak.
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STUDY AREA @ KUNDASANG, SABAH

Legend
- Zoning of Debris Flow

Coordinate System: GDM2000 BRSO East Malaysia
Projection: Rectified Skew Orthomorphic Natural Origin
Datum: GDM2000
Unit: Meter

Scale: 1:60,000

Kilometers: 0.0 0.4 0.8 1.6 2.4 3.2
Sendai Framework for Disaster Risk Reduction 2015-2030: Progress & Challenges

Complexity of disaster – multisectoral & disciplinary group - special need & interest
Action oriented program – scientific-based decision support – transdisciplinary approach
National Conference on Science, Technology and Innovation for Disaster Risk Reduction 2019, October 2019 @ Kuala Lumpur

Asian Ministerial Conference on Disaster Risk Reduction 2020

Global Platform for Disaster Risk Reduction 2021

Interested for collaboration, please drop your email @ khamarrul.kl@utm.my #DisasterRiskUTM
Harnessing and promoting Transdisciplinary Approach for bringing science into practice & word into action

Advancing science and technology for disaster risk management and reduction

Nurturing local knowledge, future talents and leaders

Owning and utilizing modern technologies and latest techniques for solving old problems (geohazard & disaster !!)

Integrating Geo-led Disaster Risk Reduction (DRR) into development planning and urban resilience

CONCLUDING REMARKS
“Change or Die
- if you don’t change, you can’t survive”

Tadashi Yanai, Japan’s Richest Man
- one of most-watched CNA Insider video of 2016

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THANK YOU FOR YOUR ATTENTION

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Geospatial Intelligence Research Initiative
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