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UNITED NATIONS
Committee on the Peaceful Uses of Outer Space

Convergence of Space Data and Information with Neural Network based AI and Blockchain for sustainable development

CANEUS MNT

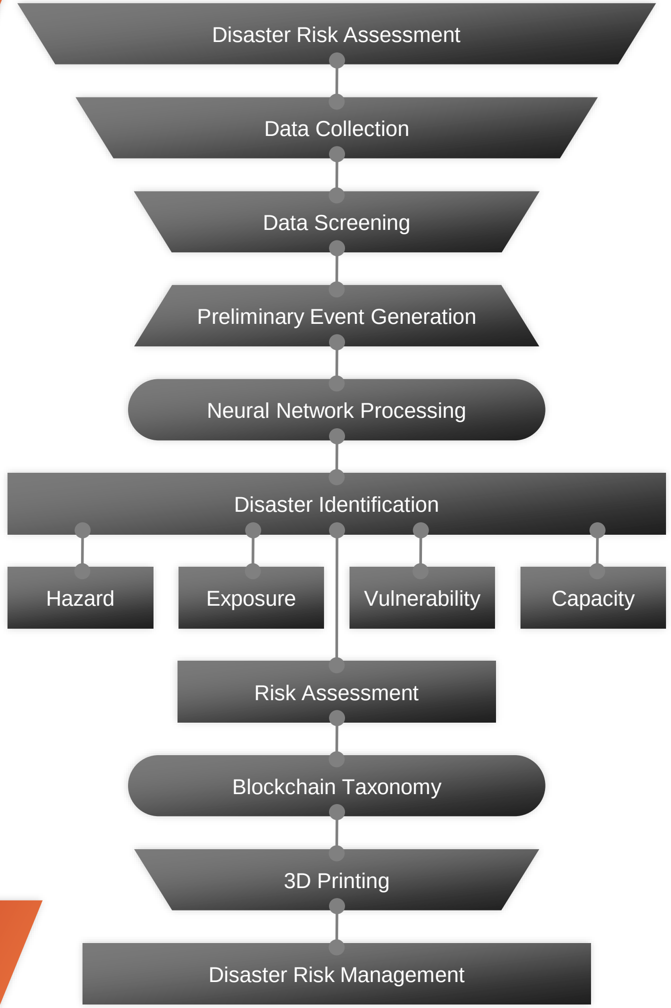
VIENNA | June 18th, 2019

Disaster Risk Prediction and Assessment Tool

Integrated artificial intelligence and blockchain technology with air, space and ground data for disaster risk prediction and assessment, leading to logistic management solutions using 3-D printing.

Presentation Outline

- Novel Concept: Integrated Solution
- Big data deep learning algorithms predictive intelligence
- Implementation Methodology
- Proposed Pilot Projects
- Opportunities for UN Member States



Novel Concept:

Integrated Approach

Emerging technologies based on **big data deep learning algorithms** and **predictive intelligence** can provide information about disasters in real-time, enabling communities to better prepare for risk estimation and management.

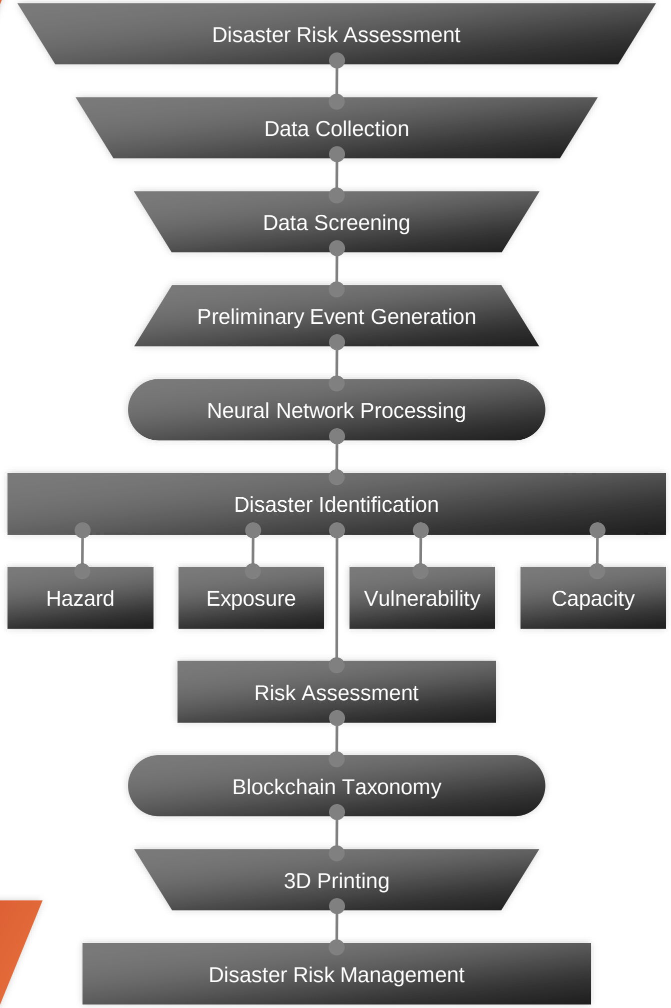
For example, earth observation images combined with ground truth data, and integrating Artificial Intelligence in the form of neural networks with Blockchain technology can support risk decision-making processes across a range of users worldwide.

Thus the proposed **integrated solution** offers a unique tool, which is affordable, can be replicated and scalable, and designed to motivate the users with novelty, thereby directly contributing to the implementation priorities for the Sendai Framework for Disaster Risk Reduction.

This novel concept is based on **integrated AI and Blockchain for disaster identification, risk prediction and assessment**, and its implementation methodology for local, regional or national scale.

Novel Concept:

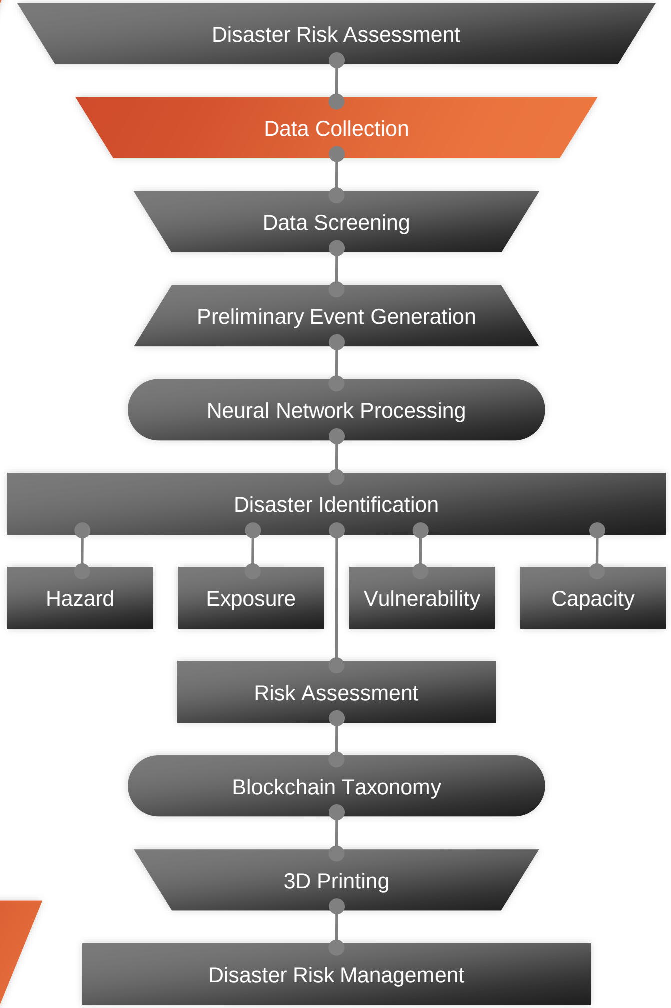
Disaster Risk Components



Components determining disaster risk—hazard, exposure, vulnerability and capacity—are **spatial / temporal in nature**, i.e. they relate to a specific geographical location, size, and extent.

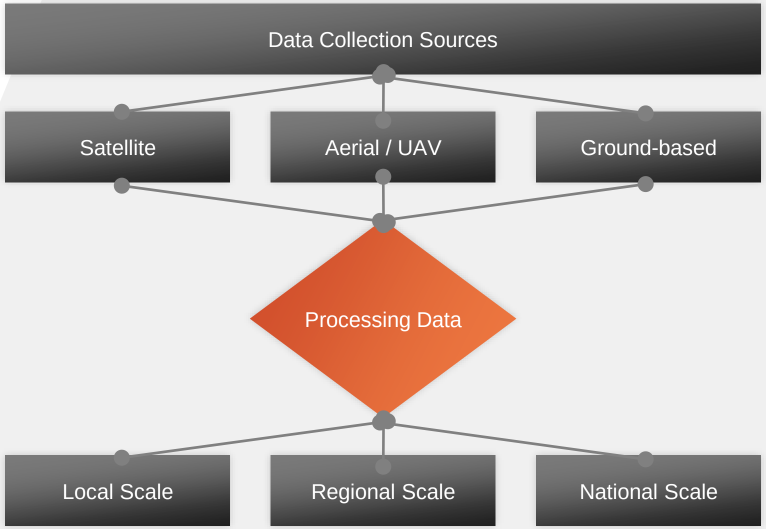
Moreover, Disaster Risk Assessment (DRA) include mapping of these components to help facilitate the visualization and communication of results to wider audience. DRAs can be conducted in relation to a single or range of multiple types of natural hazards.

The DRA identifies and analyzes the **types, intensities, and probabilities** of natural hazard events and the resulting impact on people, communities, and assets with a defined spatial location.



Concept:

Data Collection and Processing



Collection of relevant data including geo-referenced maps, aerial photos, and satellite images, etc, which needs to be digitized and introduced to neural network inputs for comprehensive analysis and disaster identification, modeling and risk assessment and prediction.

Natural hazards can be very localized and small or very extensive, affecting large areas covering regional or national level.

Additionally, there can be a significant distance between the source of the hazard and the areas affected.

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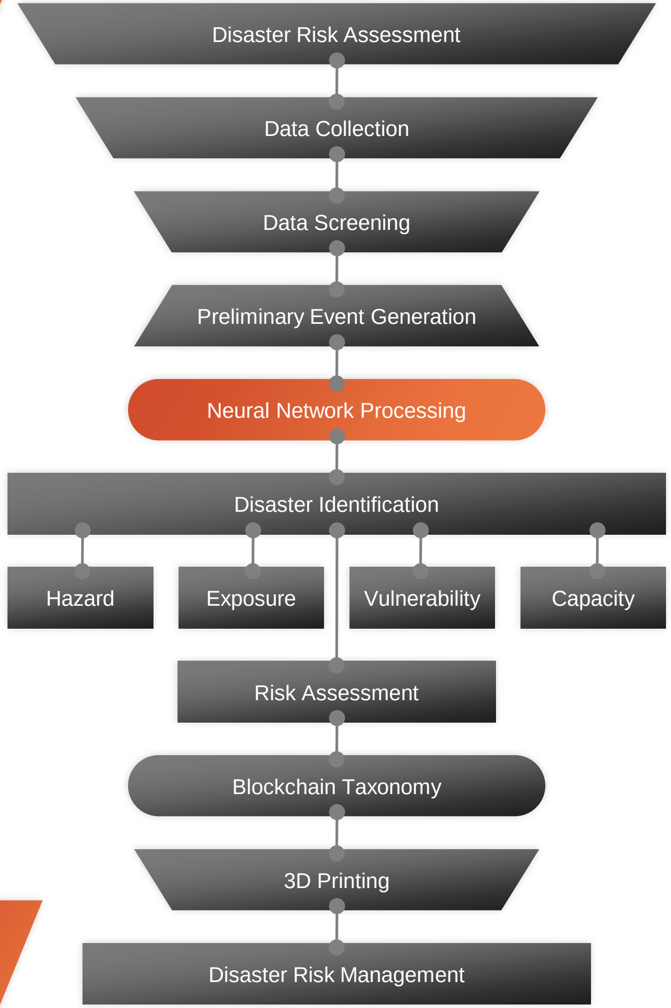
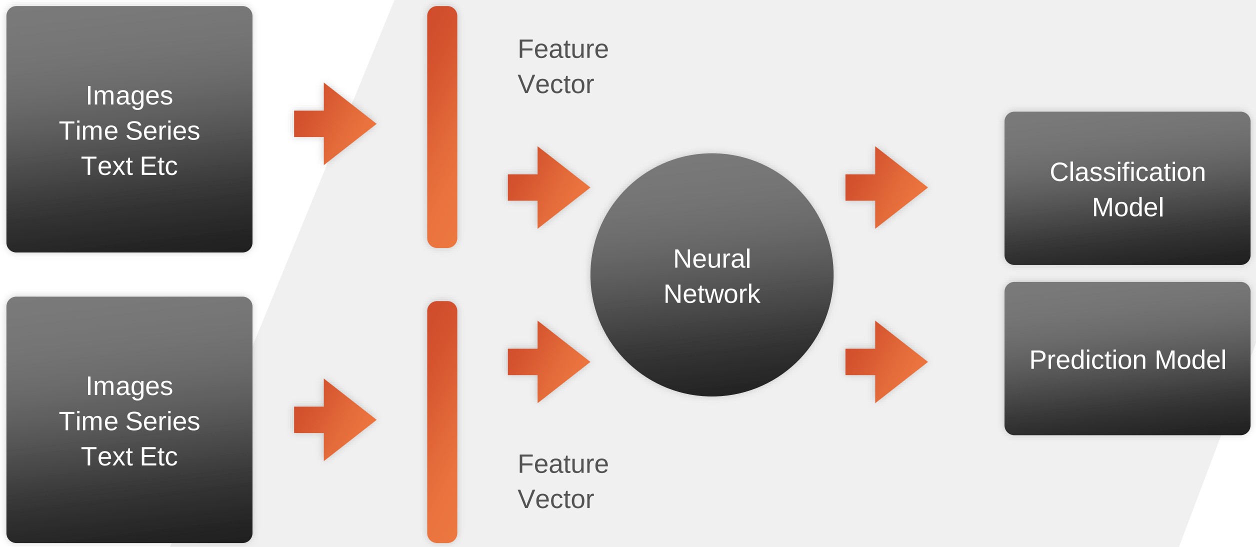
Concept:

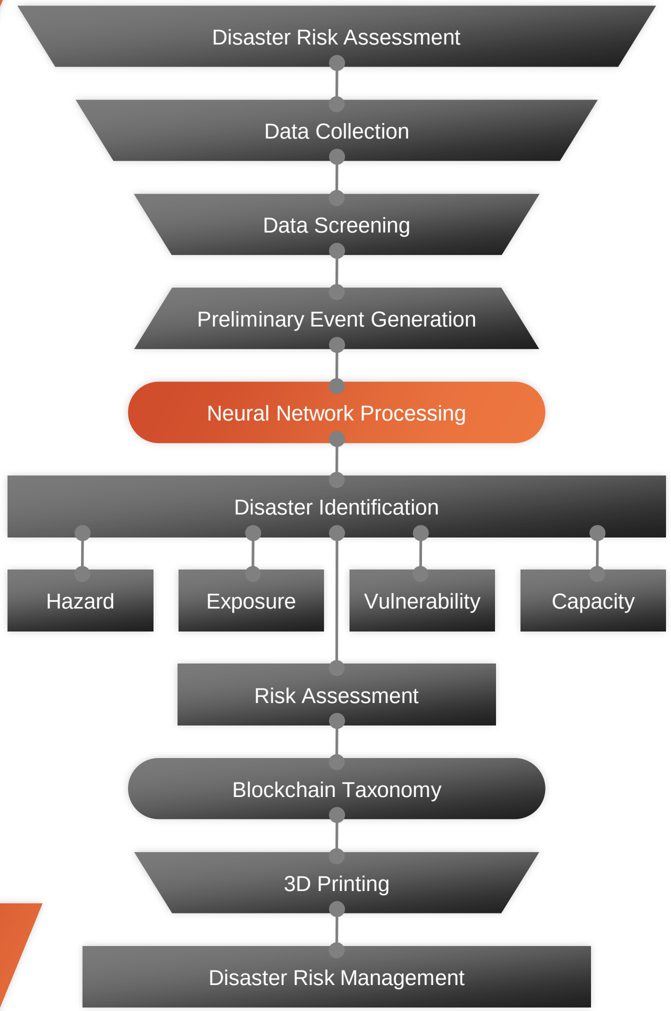
Neural Network Processing





Using historical relevant data, a set of training neural networks (NN) are able to estimate probability of disaster, **its identification and class** from real time observation particular disaster problem from trained NN outputs.

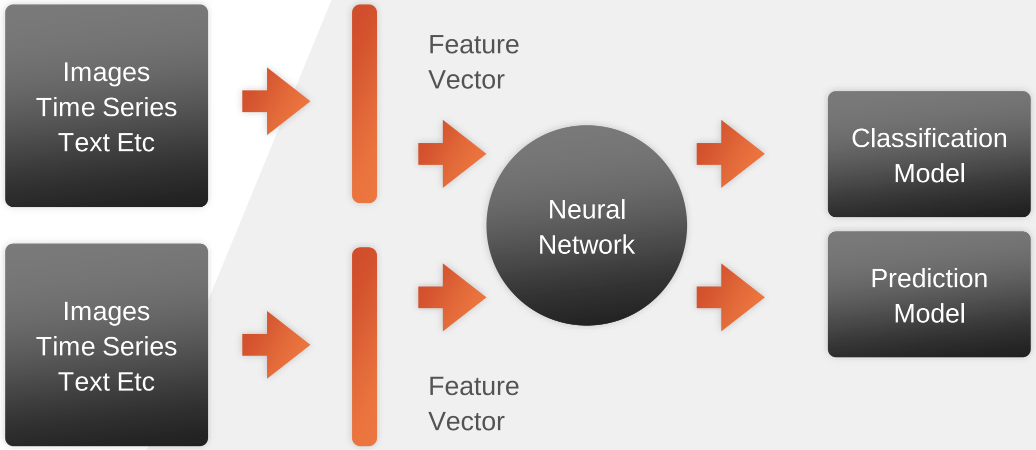
- NN have advantages compared to others because of its ability to find and use nonlinear correlation in analysing data and provide better accuracy for solving classification and prediction tasks.
- It addresses the division of data into training, validation, and testing sets, as key to evaluate the performance of neural network.



Concept:

Neural Network Processing

The training **sets of NN**, developed for each type of disaster, are applied to real time data in order to get probability of disaster occurrence and its identification scorecard hazard information, exposure, vulnerability and capacity which is used for DRA.



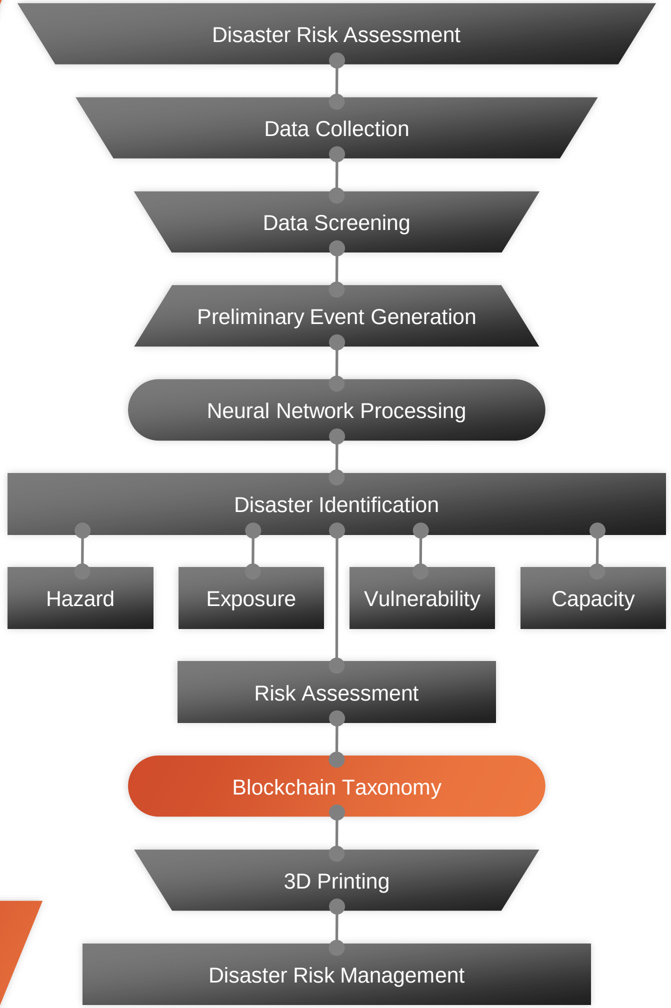
These include:

Hazard assessment covering hazard ranking, modeling and mapping.

Exposure assessment covering data, maps of project footprint and impact areas.

Vulnerability assessment covering vulnerability data, diagrams and maps.

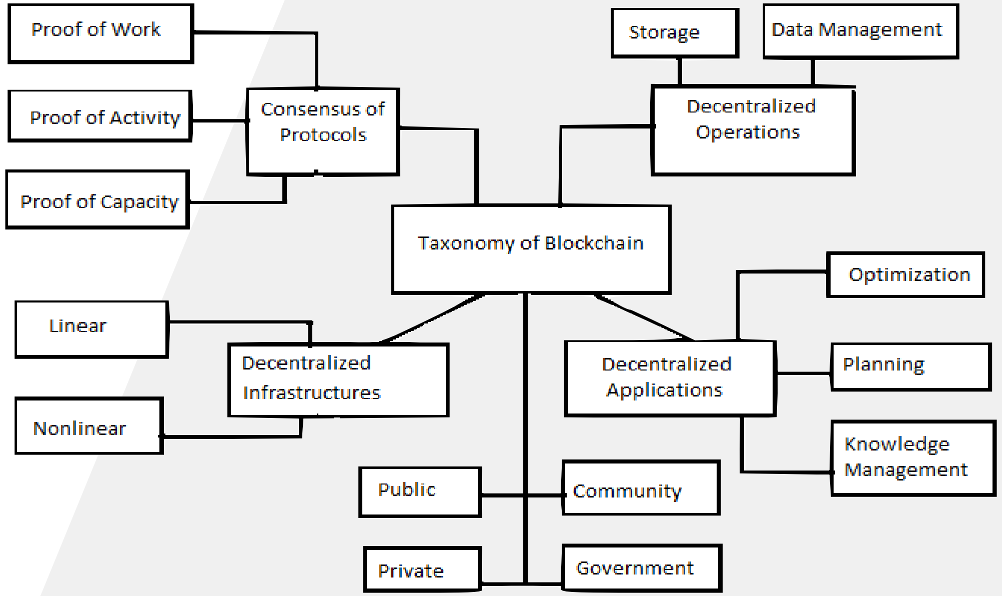
Combining these assessments, a quantitative or semi-quantitative analysis of hazards, exposure, and vulnerability are done to estimate expected damage and loss curves either for single and multiple hazards, alongside identification and justification of options to reduce and manage disaster risks.



Concept:

Taxonomy of Blockchain for AI

This step covers outputs of NN in terms of classification and prediction models for different hazardous scenarios and risk assessment offering decision-making capabilities which could be further **decentralized using blockchain application**.



Whereas, AI is known to work with huge volumes of data, blockchain offers a trusted platform to govern **among participants involved in decision making or generating and accessing the data.** *Blockchain alone has weaknesses such as scalability, and efficiency; AI has issues such as trustworthiness and privacy, therefore, their convergence complements each other.*

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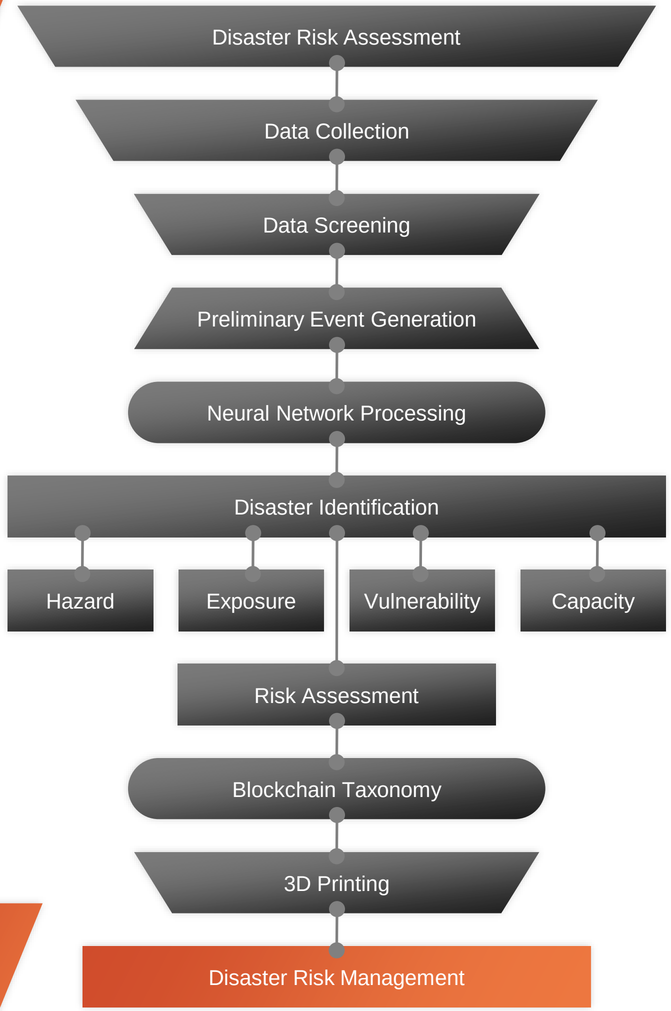
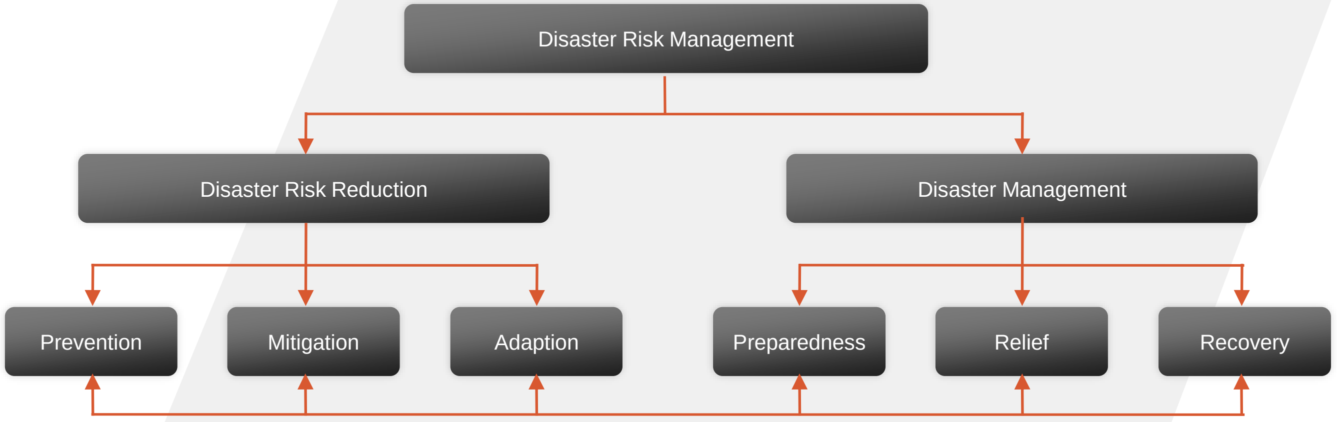
Concept:

Disaster Risk Management Components

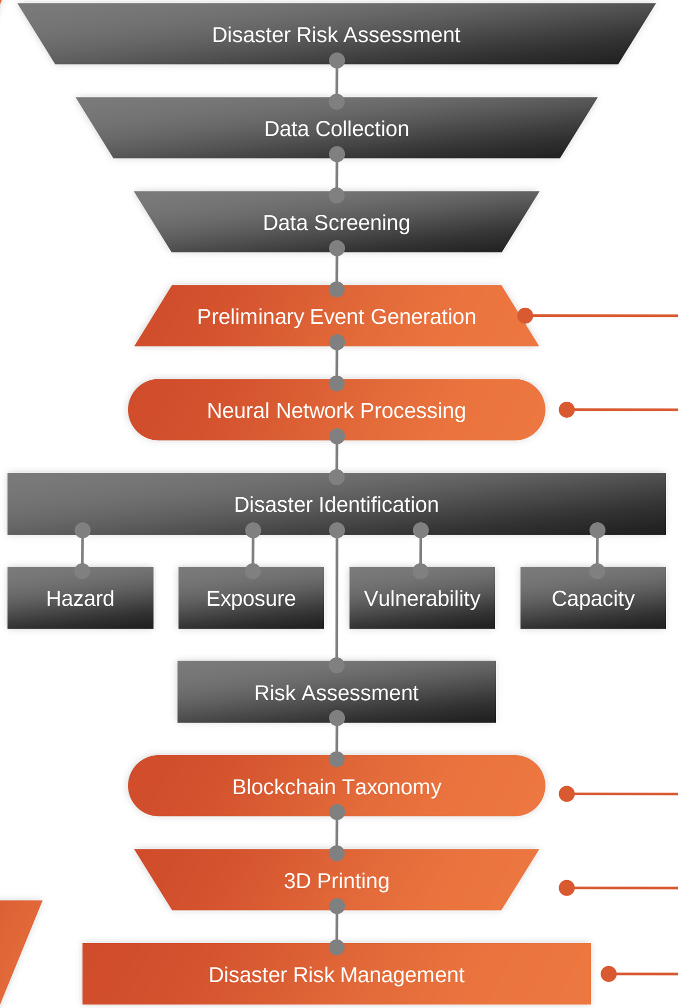




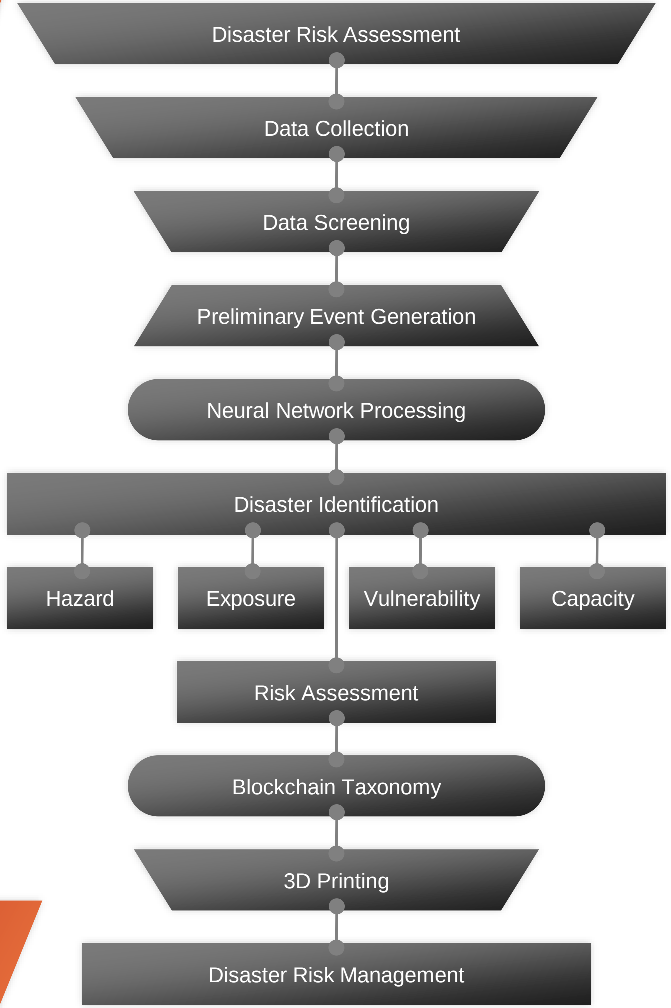
The integrated AI and Blockchain solution enables stakeholders during disaster management situation to communicate effectively and act on time. It creates a trusted environment that **supports accountability and governance**, thus addressing the three components of Disaster Risk Management (DRM), i.e. **preparedness, relief and recovery**.

Concept:

Expected Output



- Remote sensing and ground true data based **Algorithms for disaster risk prediction** and assessment based on real-time and historic dataset;
- Neural network **predictive models** for preliminary physical and economical damage estimation;
- Blockchain technology based **logistic management solution** system;
- **3-D printing** to reduce time and money by producing goods cost-effectively locally; and
- A **disaster recovery plan** covering required actions and role of each stakeholder.



Concept:

Case Studies

For flood response projects, we used the tool **to monitor risk factors and surface data about potential risks to proactively manage floods** and easily get ahead of water-related disasters in the area.

Leveraging space/ground data, social media indicators, and crowdsourcing, neural network is used to create a log of reported flood data.

Based on past and real-time data, the tool provides predictions about what would happen if an disaster event occurred in a particular area—and then implements it further by analyzing past events to see whether their predictions are any good, revising the predictive models accordingly.

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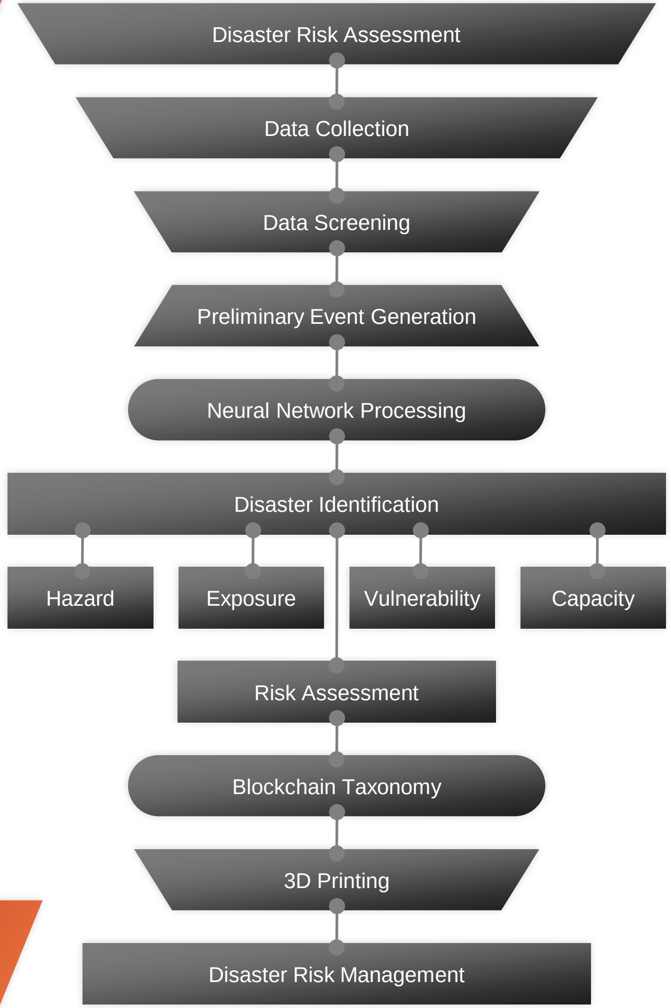

Concept:

Case Studies

Landslide evolution is a complex nonlinear dynamic process, and is influenced by geological conditions of landslide mass and external triggering factors.

The conventional ANN models can process nonlinear problems, however, **the selection of network structure and parameters is most important CANEUS contribution**.

Pilot Project - Way Forward

1. CANEUS to develop proposal to undertake a pilot project focusing on select needs of state / region / country

2. CANEUS to create neural network prediction model for one or more events using corresponding history of event in terms time series as inputs to generate the NN algorithms

3. Partner to further scale up the project to serve the disaster prediction and preparedness needs which may spans several bio-geographic, hydro-meteorological and agro-climatic zones.

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