Indonesia and Japan Disaster Management's Artificial Intelligence: Civil Engineering, Industrial Engineering and Business Engineering Trilogy

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Abstract

Disaster management is considered global jeopardies toward humankind toward their sustainable development goals. Technology driven for this disaster management plays vital role in responding and recovering disaster management within mitigated risk. The technology refers to Artificial Intelligence Technology for disaster preparedness, response and recovery. Indonesia and Japan Disaster Management is chosen as comparative analysis due to its similarities and differences between two countries that are prone to disaster. In this paper, the Artificial Intelligence's technology and method refer but not limited to method of Expert Systems (ES), Artificial Neural Network (ANN), Fuzzy Logic (FL), Support Vector Machine (SVM), and Adaptive Neuro-Fuzzy Interface System (ANFIS). The objective of this paper is to generate comparative analysis between Indonesia and Japan Disaster Management. Eventually, this paper is intended to intertwine Artificial Intelligence with Disaster Management. The approaches to intertwine both aspects are conducted within Trilogy of Civil Engineering, Industrial Engineering and Business Engineering. As research methodology, this paper elaborates both theoretical and empirical perspectives, that commence with global perspective and eventually it shortlists into the comparative analysis between Indonesia and Japan Disaster Management. Within the Engineering Trilogy, to begin with, Civil Engineering toward disaster management considers wide spectrum of theoretical and empirical perspectives to augment disaster resilience. Furthermore, Industrial Engineering and to some extent the Industrial and System Engineering, synergize the disaster management within its supply chain and digital transformation's information system as competitive advantage. Eventually, the Business Engineering wraps up both Civil Engineering and Industrial Engineering into integrated Business Strategies, through the Technology Driven including Artificial Intelligence.

Keywords
Disaster Management, Artificial Intelligence, Indonesia, Japan and Business Engineering Strategies

1. Introduction
Disaster management is considered global jeopardies toward humankind toward their sustainable development goals. Technology driven for this disaster management plays vital role in responding and recovering disaster management within mitigated risk. The technology refers to Artificial Intelligence Technology for disaster preparedness, response and recovery.

There are significant scholar works throughout the year of 2005 until 2020 on both theoretical research and empirical research of disaster management (Sood and Rawat, 2021), as illustrated in Figure 1. It is interesting to observe the countries that are adequately productive to conduct research on disaster management. In the most productive ranks

until the less productive ranks, in Table 1, those countries are 1. India, 2. United States of America, 3. Germany, 4. China, 5. Japan, 6. United Kingdom, 7. Australia, 8. Malaysia, 9. Italy, and 10. France.

Figure 1. Countries with Productive Publication on Disaster Management

Table 1. Country Names and Its Rank on Disaster Management Publication 2005 until 2020

Rank	Country Name
1	India
2	USA
3	Germany
4	China
5	Japan
6	UK
7	Australia
8	Malaysia
9	Italy
10	France

In the discourse of this paper, Artificial Intelligence Technology plays vital roles for the following disaster management categories, but not limited for disaster preparedness, response and recovery. Indonesia and Japan Disaster Management is chosen as comparative analysis due to its similarities and differences between two countries that are prone to disaster. In this paper, the Artificial Intelligence's technology and method refer but not limited to method of Expert Systems (ES), Artificial Neural Network (ANN), Fuzzy Logic (FL), Support Vector Machine (SVM), and Adaptive Neuro-Fuzzy Interface System (ANFIS).

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commence with global perspective and eventually it shortlists into the comparative analysis between Indonesia and Japan Disaster Management.

2. Comparative Analysis on Indonesia and Japan Disaster Management

Indonesia and Japan Disaster Management is chosen as comparative analysis due to its similarities and differences between two countries that are prone to disaster. Precisely, this paper conveys comparative analysis from lens of disaster management regulations in both countries, including the similarities and differences. To begin with both countries are prone to disaster due to its geographical profiles as its similarities among other significant factors. Furthermore, in term of differences among other significant factors, there are the considerations of whether the disaster management coordination is overlapping or not, in each of the mentioned countries.

In term of the aforementioned differences on coordination (Lestari et al. 2020), Indonesia National Disaster Management Agency is known as Badan Nasional Penanggulangan Bencana (BNPB) that oversees its specific Regional Disaster Management Agency, known as Badan Daerah Penanggulangan Bencana (BDPB). BNPB's chain of commands comprise Chairperson in the helmet, and subsequently Steering Committee within sub team. This Steering Committee is teamed up from Government Officials of wide spectrum of either institutions or ministries. Ultimately, in the other command perspectives, the Executive Committee in BNPD is reporting to President of Republic Indonesia.

As comparative analysis between Indonesia and Japan's Disaster Management, then, Japan has its own characteristics. Japan disaster management constitutes many participants in lieu of merely one single centralized chain of command. The mentioned participants are wide spectrums of Japan Prime Minister that takes the helmet as chairperson for Disaster Management Council. This council is aided by expertise in ministry on multidisciplinary and multi relevant ministries, public companies and community empowerment.

3. Artificial Intelligence's Technology Driven on Trilogy of Civil Engineering, Industrial Engineering and Business Engineering.

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Table 2. Artificial Intelligence: Methods in Three Stages of Natural Disaster Management

Models (Top 10)
Artificial neural network (ANN)
Support vector machine (SVM)
Fuzzy logic (FL)
Regress algortihm (RA)
Genetic algorithms (GA)
Random forest (RF)
Robotics
Bayesian (Bayes)
Extreme learning machine (ELM)
Decision tree (DT)
Wavelet analysis (WA)
Expert system (ES)
Particel swarm optimization (PSO)
Search Algorithm (SA)

Similar to Indonesia and Japan, then other countries have to consider subsequent series of disaster management as precautions in at least three stages (Tan et al. 2021) of Natural Disaster Management, known as NDM, as illustrated in Figure 2. This NDM comprises precautions actions prior, during and posterior the occurrence of disaster. Those actions are meticulously categorized as disaster preparedness, disaster response and disaster recovery, according several scholar works (Wex et al. 2014).

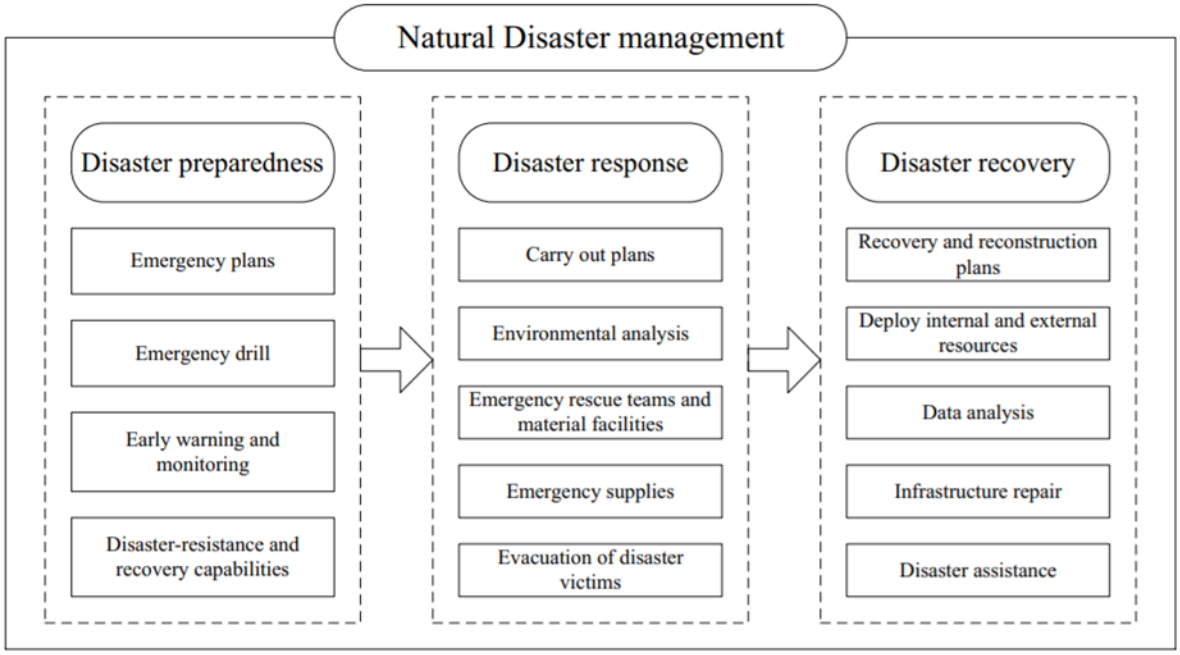

Figure 2. Natural Disaster Management (NDM) and its Three Stages

In first stage of NDM, which is disaster preparedness, the key factors are to define emergency plans, proceed to emergency simulations. Subsequently this stage is intended to ameliorate capabilities in term of preliminary alert toward recovery (Ahmadi et al. 2015), (Mashi et al. 2019). Subsequently, in second stage of NDM, which is disaster response, the key factors are to ensure socioeconomic system stability in the event of disaster, in order to save save people's lives, and to minimize the economic losses (Caunhye et al. 2012), (Wu and Cui 2018). The key factors are furthermore considering early stage plans implementation and related NDM, emergency material hauling and evacuation process (Anaya-Arenas et al. 2014), (Poblet et al. 2018). Ultimately, in the third stage of NDM, the key factors are to reduce time recovery in an effective procedures within internal and external resources (Sahebjamnia et al. 2015).

Eventually, this paper is intended to intertwine Artificial Intelligence with Disaster Management. The approaches to intertwine both aspects are conducted within Trilogy of Civil Engineering, Industrial Engineering and Business Engineering. As research methodology, this paper elaborates both theoretical and empirical perspectives, that commence with global perspective and eventually it shortlists into the comparative analysis between Indonesia and Japan Disaster Management. Within the Engineering Trilogy, to begin with, Civil Engineering toward disaster management considers wide spectrum of theoretical and empirical perspectives to augment disaster resilience. Furthermore, Industrial Engineering and to some extent the Industrial and System Engineering, synergize the disaster management within its supply chain and digital transformation's information system as competitive advantage. Eventually, the Business Engineering wraps up both Civil Engineering and Industrial Engineering into integrated Business Strategies.

4. Results and Discussions

Technology Driven is one of the important factors in disaster management, including the Artificial Intelligence Technology. There are many interpretations and definition (Poole and Mackworth 2010) and (Russell and Norvig, 2016) on Artificial Intelligence (AI). This paper defines AI as domain that integrates multidisciplinary of trilogy

among computer science, mathematics, and physics. This AI incorporate holistic perspectives of not only philosophy, but also perspectives of neuroscience psychology and wide spectrums of relevant domains.To some extent, from 1996 until 2020, there are prolific publications of Natural Disaster Management (ND) using Artificial Intelligence (AI) Models, as illustrated in Figure 3.

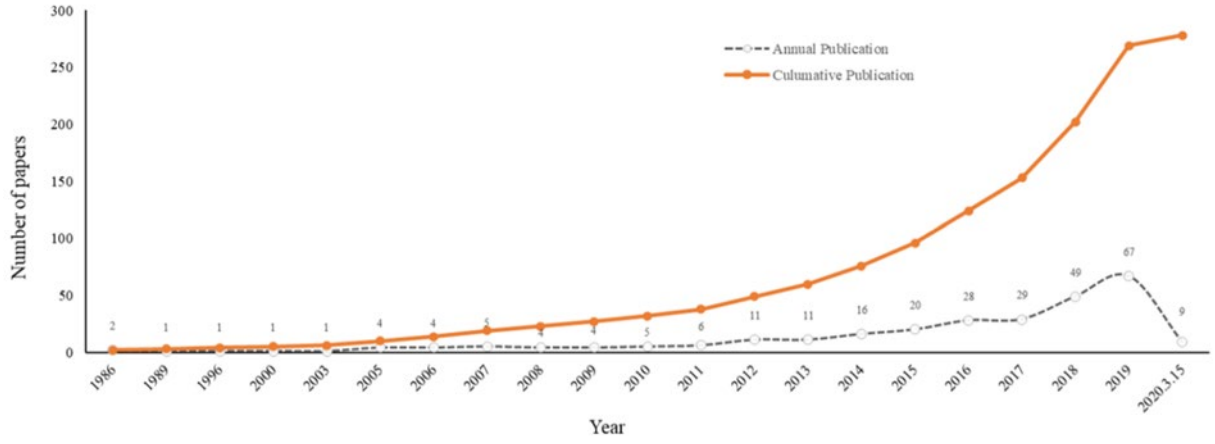

Figure 3. Natural Disaster Management (ND) using Artificial Intelligence (AI) Models

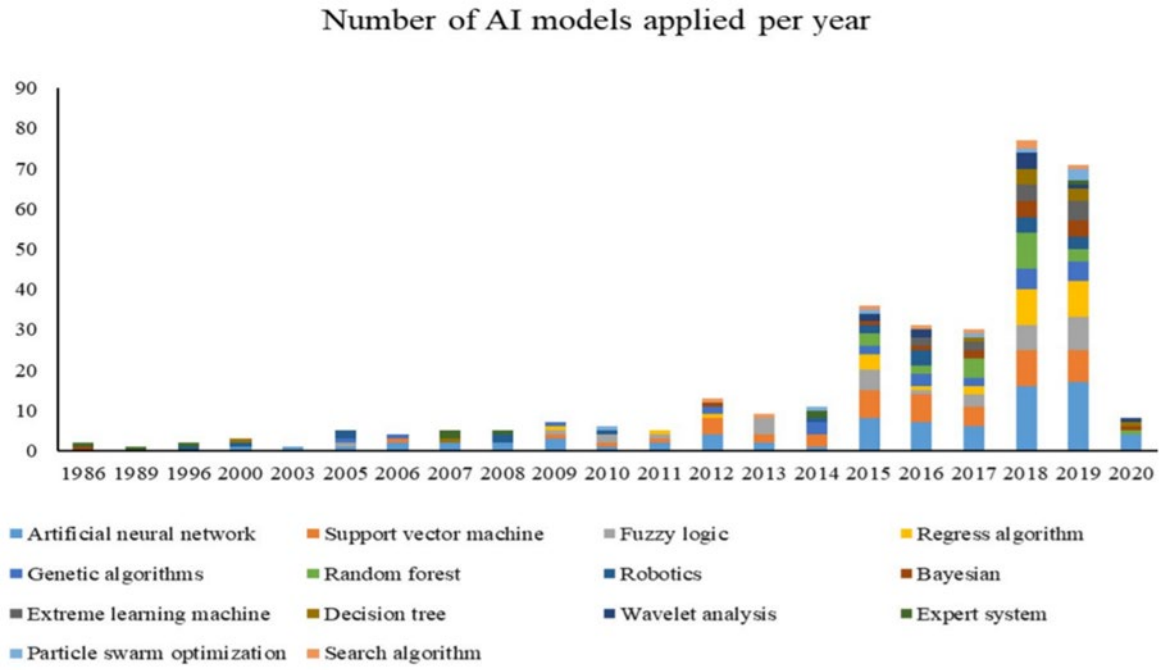

Figure 4. Artificial Models and its Application throughout 1986 until 2020

According to scholar works of Tan et al in current 2021, Artificial Intelligence (AI) is shown in Figure 4, the increasing popularity, not only AI in general, but also in its application for Natural Disaster Management (NDM), including the Journals on NDM using AI, for specific future research in relevant topics as shown in Figure 5.

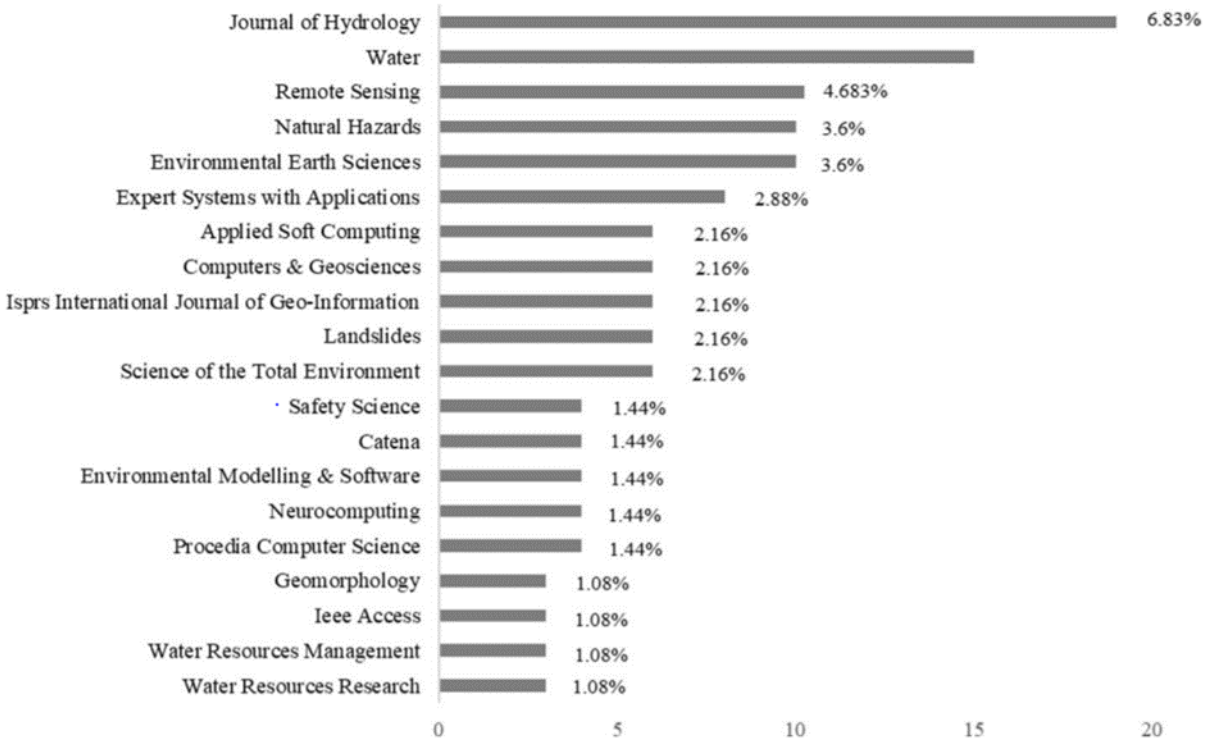

Figure 5. Journals on Natural Disaster Management's specific topics on Artificial Intelligence

5. Conclusions

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Similar to Indonesia and Japan, then other countries have to consider subsequent series of disaster management as precautions in at least three stages of Natural Disaster Management, known as NDM. This NDM comprises precautions actions prior, during and posterior the occurrence of disaster. Those actions are meticulously categorized as disaster preparedness, disaster response and disaster recovery, according to several scholar works. Ultimately, it can further be improved for future research in both theoretical and empirical perspectives, not only in Indonesia and Japan, but also for the rest of countries worldwide.

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Biographies

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