Geo-intelligence for Disaster Management: Opportunities from DTI Perspective

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ABSTRACT

The talk describes the project that integrated three target technologies of Defence Technology Institute (DTI), namely military simulation and training, information and communication, and unmanned vehicle to come up with an application for military assistance in time of communication blackout. The research project took four years from 2018 to 2021 with objectives of adopting the geo-spatial data for 3D flood simulation and the realm of command, control, communication, computer, intelligence, surveillance and reconnaissance (C^4ISR) for disaster management. That ISR initiative engaged the project researchers with the process of capturing geo-spatial data, handling geo-informatics and extracting geo-intelligence for *damage assessment, forcible entry, locating victims, search and rescue, and evacuation.* The project gained recognition from various Thailand's Defence and security agencies. Currently, DTI has been contacted by *Directorate of Joint Civil Affairs* that is a major co-player on disaster management of the ministry of Defence to renew the project and extend the area to cover Thailand's central river basins of 91,731 sq.km. The project will serve more than 20 million people of central Thailand who live their lives familiarizing with annual and frequent floods. The project researchers will engage with big geospatial data and need to embrace national and international collaboration. Opportunities are open for DTI to have agreements and cooperation, to generate joint venture, holding companies, or to partner with both domestic and international juristic entities organizations. Where disasters know no boundaries, this disaster management project is expected to take geo-intelligence to another level among Thailand's agencies of Defence technology and industry.

Keywords: Geo-intelligence, Disaster management, Defence technology and industry, Dual-use geo-intelligence

1. The Integration of Geo-intelligence enabled Technologies

Figure 1: The principle of DTI disaster management.

The principle of DTI disaster management project lies in the integration of the institute's target technologies including unmanned vehicle system, information and communication technology, and military simulation and training. Geospatial data was gathered by the unmanned vehicle system or known as drone as shown on fig. 1 far left, stored on a map server, pre-analyzed by a GIS capability package in order to be displayed for a real-time, user-interaction dashboard. The previous study area covered only 41 sq.km., making drone terrain modeling achievable at the fine spatial resolution of 6 cm. A more technical handling approach that comes with a required larger area extent opens more financial *opportunities* to the higher altitude of air borne and space borne data acquisition. In response to flood situation, the flood response unit is commissioned under communication blackout situation but data and information from the affected area need continuous injection to the data and information flow, see the *Mission execution* of fig. 1. This initial point creates the awareness of victims' personal data that the response unit need to handle the mission with utmost care in compliance with *Personal Data Protection Act*. An *opportunity* for *Encryption/Decryption* hardware and software handling is wide open provided that the response unit team is free from hardware and software handling difficulties. Big spatial data modeling and analysis at the data communication and analysis domain of fig. 1 results in field geo-intelligence production in form of standard operating procedure (SOP) that is disseminated back to the execution team or straight to the command and control domain. Software integration and hardware interface are intense in the mobile C^{4}ISR vehicle. While the geo-intelligence is produced onsite and near to the affected area, intelligence-based decision is made at the command and control domain with near real-time situation awareness made possible by the established communication relay system. Logistics which is best served by the armed forces is centrally controlled within this domain and locally distributed at the affected area. The three-dimensional common operating picture or 3D COP is shared across the data and information flow.

2. Data/Information/Geo-intelligence Flow for Disaster Management

Figure 2: The data flow within the C^{4}ISR mission.

The stage of data, information and geo-intelligence is realized for disaster management as shown on fig. 2. It resembles the concept of mobile command, control, communication, computer, intelligence, surveillance and reconnaissance (C^4ISR) in the military mission. The establishment of near real-time communication relay with help from *Aerial station* for the installation of communication devices was conceptualized in [1], [2] with a multi-rotor aerial vehicle equipped with a video camera for monitoring of ISR missions to extend the monitoring effort by *Incident command* to as far as 150 km. in full relay capacity. A bundle of signal, data, text, image and video was relayed from *Response unit* by a military grade man pack via the hovering *Aerial station* at 9,000 feet above or away. At *Incident Command*, the flow of data communication for C^4ISR mission is enabled by the attachment of receiving and sending antenna on the mobile vehicle where a great deal of hardware and software interfaces takes place to perform geo-intelligence, modeling and analysis for first-hands standard operating procedures (SOP). Besides 3D terrain modeling and mapping, *Incident Command* also mediates command and communications between *Command and Control* center and *Response unit* through *Aerial station*. Near real time situation awareness on 3D common operating picture is available at *Command and Control* for executives to make decision on proposed and finalized SOPs. Another *opportunity* is open for the established system of fig. 2 to provide flood response training for defence and security agencies with humanitarian aid and disaster relief (HADR) missions. The activities detailed within each station of fig. 2 can be further grouped into modules of live exercises. Command post ones can also be drafted from the activities of the *Command and control center*.

3. Geo-intelligence for Standard Operating Procedures

The military mission execution needs practice command and control guidelines. Those are considered *military Standard Operating Procedures* for disaster management. They include *Damage Assessment*, *Forcible Entry*, *Locating of Victims*, *Search and Rescue*, and *Victim Evacuation*.

Figure 3: Dashboard detailing flood damage assessment.

The dashboard for *Damage Assessment* shown on fig. 3 was achieved via *Memorandum of Agreement* between DTI and *Chiang Mai University*. This online provision of flood simulation over 40 sq.km. covers some part of a district in the Northern province of Thailand under the responsibility of a *Mobile Development Unit* of *Armed Forces Development Command* of *the Royal Thai Armed Forces Headquarters*. It engages map users with data and information necessary for flood *Damage Assessment*. The damages to construction and agriculture were pre-analyzed by GIS capability on *Landuse map of 2020*. Field survey was also conducted to achieve up-to-date data of constructions such as buildings, houses etc. The extent of damaged area and the number of affected people were summarized on the above right corner of fig. 3. Current *Landuse map*, updated terrain data, and frequent and thorough field survey of an area is needed and even big spatial data for larger area extent opens an *opportunity* for big spatial data providers and geo-spatial data business and industry. Furthermore, the *Forcible Entry* SOP requires the road network, waterways and proper DEM to analyze for the access to the affected area by military barges or trucks of the *Royal Thai Armed Forces*. This is the geo-intelligence enabled intelligence from the *Command and control center* preparedness to the *Incident Command* station. Decision is made before dispatching the disaster relief team to the affected area. Therefore, processes of capturing geo-spatial data, handling geo-informatics and extracting geo-intelligence come with *opportunities* for geo-intelligence to enable decision makers' access to *Locating of Victims*, *Search and Rescue*, and *Victim Evacuation*.

4. Current Need of Geo-intelligence for Disaster Management of 91,731 sq.km.

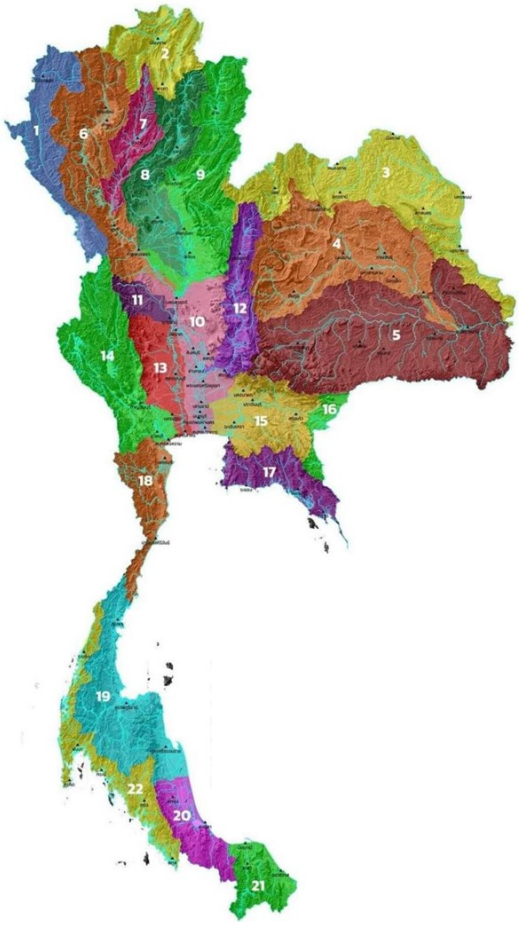

Figure 4: Current project of River Basins at no. 10, no. 11, no. 12, no. 13, no. 14, and no. 18

The *Directorate of Joint Civil Affairs* of *the Royal Thai Armed Forces Headquarters* is a major co-player on disaster management of Thailand's *Ministry of Defence*. The current need of geo-intelligence for disaster management covers an area of 91,731 sq.km. This large area extent is called central Thailand River Basins. It includes *Chao Phraya River Basin* with an area of 20,125 sq.km. (no. 10), *Sakae Krang River Basin* of 5,192 sq.km. (no. 11), *Pa Sak River Basin* of 16,292 sq.km. (no. 12), *Tha Chin River Basin* of 13,682 sq.km. (no. 13), *Mae Klong River Basin* of 30,837 sq.km. (no. 14), *Phetchaburi River Basin* of 5,603 sq.km. (no. 18) shown in fig. 4. The project will serve more than 20 million people of central Thailand who live their lives unwillingly familiarizing with annual and frequent floods. The *Command and Control Center* will help the *Directorate* for the disaster management preparedness, prevention and mitigation. Moreover, the *Directorate* has an ambitious goal to establish a regional disaster relief training center to provide skill training for the personnel of the military units to perform rescue and disaster relief operations for the people at the village level in a timely manner. The training is reaching out to the *Department of Disaster Prevention and Mitigation* of the *Ministry of Interior*, the *Army*, the *Navy*, the *Air Force* and other government agencies for an orchestrated operation only achieved with joint/combined disaster relief trainings. *Opportunities* for the agreements and cooperation with DTI to conduct research and development on the process of capturing geo-spatial data, handling geo-informatics and extracting geo-intelligence are open for both domestic and international juristic entities organizations. Long term engagement with DTI can be in form of either joint ventures or holding companies. That comes with many open *opportunities* for other untouched River Basins or even other kinds of disaster.

5. DTI's Open Opportunities for Domestic and International Collaboration

Disasters become a frequent yet unwelcome guest not only to residents and villagers living in Central Thailand River Basins but also to foreign investors having their business facilities established in the region. Flooding, for example, has caused lives and casualties of world population with no recognition of national boundaries or sovereignties. In 2011, severe flooding occurred during monsoon season in Thailand. The flooding began at the end of July triggered by the landfall of Tropical Storm Nock-ten and was described as the worst flooding in terms of the amount of water and people affected. On 6 November, flooding affected 3,151,224 people from 1,154,576 families with several hundred deaths and a lot missing. The damage was estimated at least 185 billion baht which included 95 billion baht damage on Thai industry, 25 billion baht damage to Thai agriculture, and 65 billion baht damage to housing. A large part of the damage stemmed from the effect on the manufacturing industry, with 930 factories in 28 provinces affected, including several industrial estates in Phranakhorn Sri Ayutthaya and Pathum Thani Provinces. At that time, Thailand was the world's second-largest producer of hard disk drives, supplying approximately 25 percent of the world's production. Many factories were flooded, including those of Western Digital. The company's flood-related costs were estimated at between US$225–275 million. The economies of other countries were significantly impacted by the flood. The country that was hardest hit was Japan. Japanese firms with plants in Thailand included Toyota, Honda, Hitachi, and Canon. One analyst predicted the profits of one firm, Toyota, may be cut by ¥200 billion (US$2.5 billion). Worker incomes in Thailand and Japan were also hugely impacted. It is obvious that disasters and their casualties know no boundaries or sovereignties but largely create domino impacts to world population, the disaster management that embraces geo-intelligence is a complete package of disaster preparedness and risk reduction.

The existing cooperation worth contemplating is Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation or BIMSTEC. BIMSTEC was established in 1997 for Multi-Sectoral Technical and Economic Cooperation. It is a gathering of 7 countries including India, Thailand, Myanmar, Sri Lanka, Bangladesh, Bhutan and Nepal. However, after 23 years, BIMSTEC is still struggling. There

are challenges to making cooperation more tangible since seven countries have a total population of over 1.6 billion people representing 23% of the world's total population with an economic value of over 3 trillion US dollars. What is more interesting is more than half of the population in BIMSTEC countries is of working age. Therefore, it is considered a region with very high production capacity. However, the productivity is highly weather dependent and somehow dictated by annual seasons, such as agricultural and industrial products, tourism and other location-based services upon which decision making on disaster management is based. Within BIMSTEC scope and disaster management opportunities, DTI will be able to explore the cooperation via the mission of defence technology R&D leading to defense industry. Several aspects of defence industry such as research, development, design, production, assembly, improvement, rebuilding, deformation, transformation of products used in national defence still await the institute to carry out the study, research, and development for those innovative products leading to the national defense industry. Under legitimate objectives, the institute is to coordinate the defence technology and industry cooperation with government agencies, educational institutes and private sectors both domestically and internationally. That legitimacy allows the institute to reach out for partners that fulfill the capacity building upon those disruptive and ever-changing technologies to realize the *opportunity* and *opportunities* indicated in this document. The cooperation may come in a number of tangible forms such as to establish or jointly form a legal entity including joint venture, holding shares or being a partner with any person or juristic person to carry out national defense industry.

6. References

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