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STUDY ON DISASTER RISK ASSESSMENT AND AREA BUSINESS CONTINUITY PLANNING IN INDUSTRY AGGLOMERATED AREAS

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ABSTRACT: Two large disasters which occurred in 2011, the Great East Japan Earthquake and the Flood of Chao Phraya River in Thailand, reminded the risks of business termination and further impacts on national, regional and the global economy through their supply chain. Prearranged Business Continuity Plans (BCP) or Business Continuity Management (BCM) System (BCMS) in private enterprises helped them survive to some extent but finally malfunctioned in continuation of their business or quick recovery from damages due mainly to disruption of business resources such as energy, water, transportation and communications that are essential for their operation.

In order to minimize the negative economic impacts or losses particularly by large scale disaster that disrupt fundamental infrastructure in wide areas, it is important to carry out risk assessment at a proper scale and to prepare scenario based disaster management plans for area-wise damage mitigation and strategic recovery. All players should share the plan and coordinate with other player's actions. In addition, it is essential to establish framework of integrated resource management at a scale of a whole industrial area for effectuating each enterprise's BCM actions in coordination with the public sector's actions.

In 2013, Japan International Cooperation Agency (JICA) proposed a new concept of disaster risk management in industrial agglomerated areas, as "Area BCP" and "Area BCM", applying to a project in three pilot areas of industry agglomeration in ASEAN region for the first substantiation of the concept.

The Area BCP designates a framework and direction of coordinated damage mitigation measures and recovery actions of stakeholders including individual enterprises, industrial area managers, local authorities and administrator of the infrastructures in order for business continuation of area-wise economy such as industrial agglomeration or urbanization.

The Area BCM then is defined as a cyclic process of risk assessment, sharing risk and impact information, determining common strategy of risk management, developing the Area BCP, implementing the planned actions and monitoring to self-improve the Area BCM System recurrently in coordination among stakeholders, in order to enhance the capability of effective business continuity of the area.

The three pilot areas selected are Bekasi - Karawang industry area in Indonesia, Cavite - Laguna - Metro Manila in the Philippines and Hai Phong industry area in Vietnam. In each area, many stakeholders from public and private sectors have been participating to the project.

Although the project is still in a first cycle of the Area BCM process, some important lessons can be explored from the conducted steps of multi-hazard risk assessment, disaster scenario projection, business impact analysis and discussions among stakeholders to formulate the Area BCP. This paper aims to identify the benefits and further challenges of the new approach for enhancing resilience of local economy.

Key Words: disaster risk assessment, business continuity, Area BCP, Area BCM, economic resilience

1. INTRODUCTION

In recent years, risks of natural disasters on economic activities have become more and more tangible. People have realized seriously that natural disasters can cause not only human causality but also impacts on national to regional and world economy.

The Great East Japan Earthquake and Tsunami in 2011 put an incredible strain on the national economy and also had global impacts through the supply chains of industry: as an example, the severely disrupted supply of Japanese-made vehicle parts to automobile assembly plants forced Toyota, GM and major automotive manufacturers around the world to shut down the production for certain period of time (Ando and Kimura, 2012).

The 2011 Flood of Chao Phraya River in Thailand again reminded us of the risks of business termination and further impacts on national, regional and global economy through their supply chains (Komori et al., 2012).

After a disaster in such industry agglomerated area, disrupted businesses will have a significant impact on the regional economy, employment and population outflow in particular, and its impact may spread throughout the nation. Hence early regeneration of local industry is essential for reconstruction of people's living environment and normalization of socio-economic activities in the rehabilitation and reconstruction phase. Furthermore, even in advance, raising the area-wise economic resilience to disaster is an important issue for a local government also for a nation.

Considering the recent increasing economic damages by disasters and recognizing the importance of private sector as actor and partner of disaster management, the Global Platform for Disaster Risk Reduction (2013) under the support of the United Nations summarized the Fourth Session that promotes economic resilience and fosters new opportunities for public private partnerships as part of an overall improved risk governance. Furthermore, it also highlighted agendas including private sector's progressively aligning risk reduction efforts and developing business practices.

The most significant contribution by the private sector for economic resilience is denoted by the Business Continuity Plan/Planning (BCP) or Business Continuity Management (BCM) System (BCMS). BCM refers to any effort that aims to achieve business continuity by doing whatever necessary to protect company's production, information, equipment, and employees. The BCP or BCMS is standardized as ISO22301 (ISO, 2012) and disseminated in many business enterprises around the world.

However, for comparatively small business enterprises, the BCP or BCMS has not been formulated nor implemented yet. This tendency is obvious particularly in developing countries where many industry agglomerated areas are located in vulnerable conditions against natural disasters.

Moreover, when a major disaster occurs, the damage extends to roads, power supplies and other infrastructure as well. Therefore, efforts of individual companies, even if BCPs are prepared, are not enough to achieve the desired level of business continuity.

In order to minimize economic impacts or losses in case particularly of large scale disasters that disrupt fundamental infrastructure in certain areas, it is important to carry out risk assessment at a proper scale and to make scenario based contingency plans for area damage mitigation. In addition, it is vital to have integrated resource management and strategic recovery plans which could support each enterprise's BCM actions in coordination with the public sector's activities.

Some studies suggested that further research on regional level management of business continuity is required. Warren (2010) explained that a significant number of public sector authorities are not preparing integrated disaster management plans nor BCPs. It is noted that further need for research exists into the impact on assets, the role of the public sector manager of certain area in assessing the risks, the strategy to prepare the coordination framework and to mitigate the effects of natural disasters and severe catastrophic events.

With this background, JICA, in collaboration with the ASEAN Coordinating Centre for Humanitarian Assistance on disaster management (AHA Centre), has launched a project type study entitled “Natural Disaster Risk Assessment and Area Business Continuity Plan Formulation for Industrial Agglomerated Areas in the ASEAN Region” since February 2013 (Baba et al., 2013). In the study, JICA proposed Area BCM for continuity of local economy in times of disaster. The initiative intended to further strengthen regional economies.

Area BCM refers to efforts of an area that, no matter what the circumstances are, it aims to prevent economic stagnation of the area. To achieve this goal, cooperation between private sectors, national government, municipalities, operators of infrastructure and utilities, and local communities in the area is necessary. Area BCM also requires process of scientific assessment, as a part of the management cycle, to have a common understanding of risks and impacts in the area which should be based on Multi-hazard, Multi-scenario and Probabilistic analysis.

By efforts of this Area BCM, it is expected that public-private cooperation will be promoted and efforts to disaster prevention by all stakeholders will be enhanced. We also expect that the economic benefits of the target area, such as the value as an investment environment, will increase.

2. INTERNAL AND EXTERNAL RESOURCES FOR BUSINESS OPERATION

When a large scale flood strikes for example, it inundates the entire area. The flood damages to the factories. In that case, companies and industrial parks must repair and replace damaged machineries to restart operations. However, their business cannot be continued by their efforts only. For a company to continue its business, restoration of public infrastructure such as power supplies, water supplies, roads, ports, airports is essential.

Analyzing the causes of operation down in recent large scale disaster cases, the elements of business resources that are crucial for production and distribution can be classified into Internal and External ones (Table 1). Internal resources, such as company’s buildings, facilities, parts and row materials, are controllable by each enterprise. External resources, on the other hand, such as energy, water and transportation infrastructures, are managed normally by public sector and not controllable by private enterprises. The external resources are also distributed not only for business purposes but also for securing community life. Therefore, in case of emergency that imposes limited allocation of those resource, collaborative efforts are required between the private sector, public sector and the local community to maintain the critical external resources.

Some External Resources often become common bottlenecks for effective business continuity in a wide area when affected by disaster. Disruption of transportation system, for example, could force all the companies to stop delivery of products and parts. It also imposes the workers and staffs to get stranded in place they were at the event occurred. If the recovery time objective is too long to commute them back home, the area all will face difficulties such as lacking foods, water and sanitation environment for them. However, if area-wise measure for stranded peoples was prepared by public sector or by some major enterprises, they can effectively solve the problem by area wide coordination.

Table 1: Internal and External Resources

	Human	Substance	Finance	Information
Internal Resources	Managers, Workers, Employees,	Buildings and facilities, Equipment, Parts and row materials, fuels,	Money, Account system, Assets,	Computer systems, Operation data, Archives,
External Resources	Public officers and workers	Energy (Electricity, Gas), Water (Supply, Sanitary and sewerage), Transportation (Road & Rail, Port & Airport, etc.)	Banking, Transaction system,	Internet, Tel and Fax, Communication system,

3. CONCEPT OF "AREA BCP" AND "AREA BCM"

Keeping the importance of business resource management in mind, the term of Area BCP has come up from the "Area Command" which is designated under the National Incident Management System (NIMS) of FEMA (Waugh 2009), as an organizational structure used to oversee the management of multiple incidents or a very large incident that has multiple Incident Command Systems (ICS) or management teams to establish critical resource use priorities between various incidents and to make relevant coordinated actions of disaster management. ICS is a subcomponent of the NIMS, as released by the U.S. Department of Homeland Security in 2004, designed to give standard response and operation procedures to reduce the problems and potential for miscommunication on incidents.

The Area BCP designates a framework and direction of coordinated damage mitigation measures and recovery actions of stakeholders including individual enterprises, industrial area managers, local authorities and administrator of the infrastructures in order for business continuation of area-wise economy such as industrial agglomeration or urbanization (Figure 1).

Since the term and concept of the "Area Command" have already permeated in many countries including the U.S., and following the spatial scope of the emergency management which "Area" indicates, the study uses the same term to designate a framework and direction of disaster management as defined above. Similarly to the Area Command in terms of managing scale, the Area BCP coordinates multiple BCPs by different enterprises in the affected area. As a point of comparison, management of the External Resources and relevant coordinated actions of disaster management should be conducted under the Area BCP.

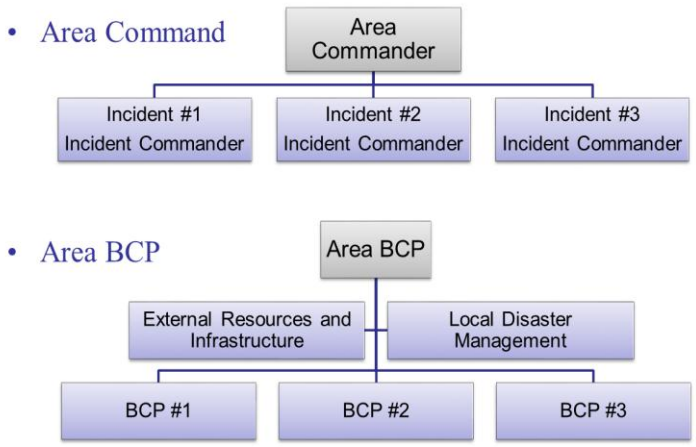

Figure 1: Area Command and Area BCP

The Area BCM then is defined as a cyclic process of risk assessment, sharing risk and impact information, determining common strategy of risk management, developing the Area BCP, implementing the planned actions and monitoring to self-improve the Area BCM System recurrently in coordination among stakeholders, in order to enhance the capability of effective business continuity of the area (Figure 2).

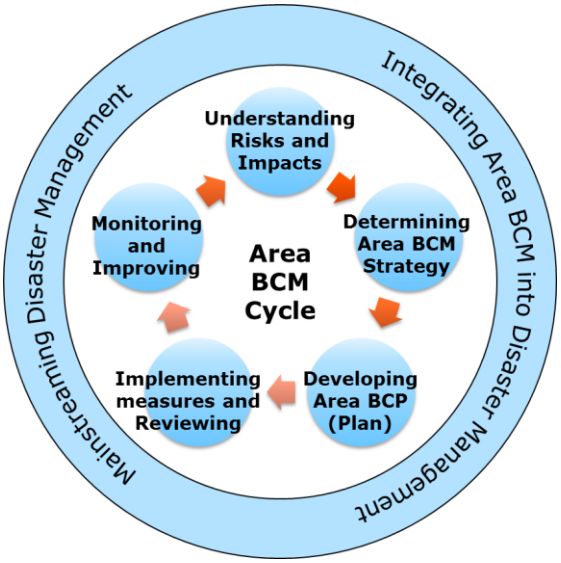

Figure 2: Area BCM Cycle

Okamoto et al. (2011) reported the process of the BCP development aimed at the establishment of the standardized crisis management system and efficient expressway operation by applying a Business Flow Diagram (BFD) and an ICS through a case study. An ICS is based upon a changeable, scalable response organization providing a

common hierarchy within which people can work together effectively. These people may be drawn from multiple agencies that do not routinely work together.

Similarly, the scale of the Area BCM system must be dynamic so that it can expand or reduce in response to the actual disaster impact and the operational situation when changed. Geographical scope of a particular Area BCP however depends on local condition or the size of stakeholder's coordination so that an industrial park, an industrial agglomerated area or even a nation can be its scope.

The coordination of stakeholders is the key of successful Area BCM. These stakeholders should include individual enterprises, industrial area managers, local authorities, administrators of the infrastructures as well as the local community.

While the BCP is designed to prevent the company's "Core Business" from being suspended in emergency circumstances, the Area BCP/BCM is to secure the "Critical External Resources", which are essential in supporting the business operation in and around the industrial agglomerated area.

4. MANAGEMENT PROCESS OF AREA BUSINESS CONTINUITY

Defined as above, the Area BCM must be conducted as a continuous cycle of improving capacity of the local resilience of economy to disasters in area wide scale. To meet this, the study designed the management process as Figure 3.

The first step of the Area BCM is that private companies, local governments, infrastructure and utility operators sit down together and have common understanding of their weakness of the area in times of a disaster. Then, the stakeholders can identify bottlenecks for the disruption of business, and come up with

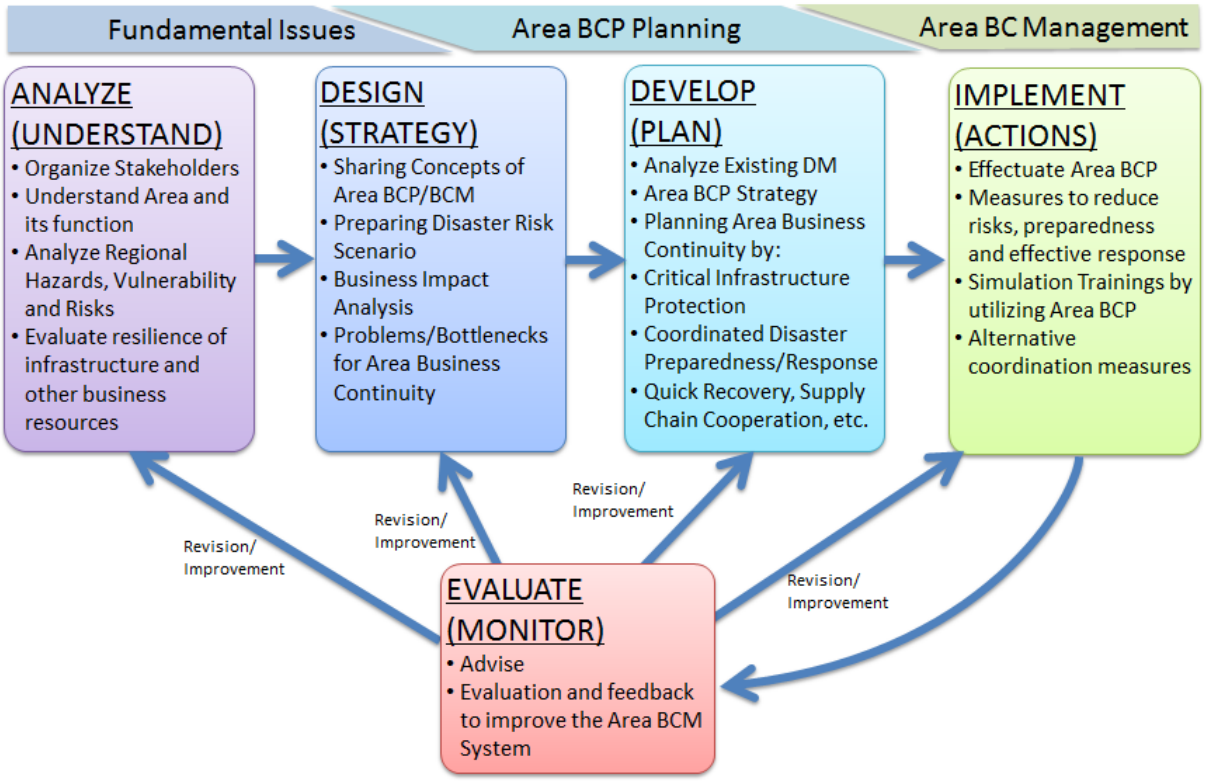

Figure 3: Process of the Area BCM

measures that will lead to a plan for business continuity of the area. Implemented measures are then monitored and evaluated for better management of the business continuity. Followings are the core steps of the Area BCM Process.

4.1 Analyze and understand the risks and impacts

In order to create common understanding of disaster risks and impacts among all participants to the Area BCM, it is essential to have scientific analysis of probable hazard, existing vulnerability and resulting risks of business interruption. Ideally, the analysis should be based on Multi-hazard (Natural, Na-tech, Manmade), Multi-scenario and Probabilistic methodology. It includes simulation of hazards in certain probabilities.

In order to prepare for the risk scenario in the target area, it is needed to evaluate the disaster resilience of infrastructure and business resources as well as the current situations of supply chains. Then we can assess the vulnerability and resilience of the elements related to the business continuity of the area.

4.2 Share the Area BCM Strategy

The result of above simulation and evaluation will be followed by business impact analysis in area wide scale as well as in each participating organization. Discussion of those impacts will then superpose the problems and bottlenecks of the area. Created risk scenario is the basic condition to discuss the risk management strategy, plans and measures by stakeholders at the next step.

Through this process, as a regulated system of risk management, the cooperation between various stakeholders is expected to strengthen.

4.3 Develop the Area BCP

This process consists of analyzing existing measures and private sector's BCPs for natural disasters, establishing strategy for Area BCP/BCM, formulating plan of cooperation, infrastructure development for more resilience, disaster response and monitoring the Area BCM activities to feedback.

The JICA's study is applying the Area BCM formulation methodology, which gives opportunities to select the single or mixed measures of; 1) Strengthening existing capacity, 2) Preparing alternative measures and 3) Making temporary back-up. The method of practice of those measures varies from; 1) Cooperation and share with other stakeholders, 2) Making new investment and 3) Transferring the risk.

4.4 Implement the planned measures

It includes preparedness for planned measures, simulation trainings, coordination activities and actual response to any emergency. This is linked with each BCP/BCM of single entity and thus every BCP should be re-designed if necessary to coordinate with the Area BCP.

The Area BCM does not always require costly investment by private and public sectors but can start from small efforts, at least such as information sharing, and promote disaster risk reduction movements as much as everyone can.

4.5 Monitor and feedback

Evaluation and feedback to the process is always important. In the Area BCM, it is designed to give advisory to all the steps of Area BCM cycle through discussions among the stakeholders. Different scenario and different hazards should also be targeted in the continuous process of Area BCM.

5. CASE STUDY OF THE PILOT AREAS

The three pilot areas are selected; Bekasi - Karawang industry area in Indonesia, Cavite - Laguna - Metro Manila in the Philippines and Hai Phong industry area in Vietnam. The areas are highly agglomerated in recent years by various industries as well as exposed to increasing risk of disasters, such as earthquakes, floods, tsunamis, typhoons/cyclones.

Through the JICA's study, we aimed to develop a standard method of formulating Area BCP and establishing Area BCM system that can be applied in many industry agglomerated areas particularly in developing countries where technical disadvantages can be found. To facilitate this purpose, the elements of the method of hazard analysis should not be unnecessarily sophisticated or highly technical. Condition of lacking basic data for analysis and financial capacity should also be considered.

Based on the above condition, the elements, i.e. tools and software, of probabilistic hazard analysis applied in the study were selected from widely used, easily handled and generally applicable ones as Table 2.

The study identified the dominant hazard in the industrial agglomerated area using probabilistic analysis of multiple hazards (Figure 4). Flood and Earthquake are the top two hazards in Bekasi - Karawang area while Earthquake in Cavite - Laguna - Metro Manila and Typhoon and Storm surge in Hai Phong area respectively are the dominants.

Disaster simulation was conducted to envisage the dominant hazard in each area projecting the severe probabilities of occurrence. We applied 100 to 200 years return period probability in this study for the severe cases of each type of hazard.

Table 2. Software tools, models and data for disaster simulation

Earthquake	Tsunami	Flood	Storm Surge
Earthquake Hazard analysis; - EZ-FRISK and GSHAP for earthquake source model, - NEHRP ground classification and amplification parameter of Building Seismic Safety Council (2009), - data used in previous JICA studies and - existing geological maps	Numerical Simulation of Tsunami Propagation and Run-up; - TSUNAMI-N1, N2, N3 by Imamura et al. (2006), - bathymetry data from GEBCO 08 Grid data (30"), - previous studies by; - Vu and Nguyen (2008), - Okal et al. (2011), - Nguyen (2011)	Indonesia; -Runoff model by IFAS -Inundation model by iRIC Philippines; -Runoff model by MIKE-11 -Inundation model by MIKE-FLOOD Vietnam; -Inland flooding by MIKE-21	Storm Surge Simulation; - Princeton Ocean Model (Mellor et al. 2004), - The Typhoon model of 2D wind and air pressure model (Myers 1954), - Bathymetry from GEBCO 08, - Elevation from ASTER GDEM and observed tide level

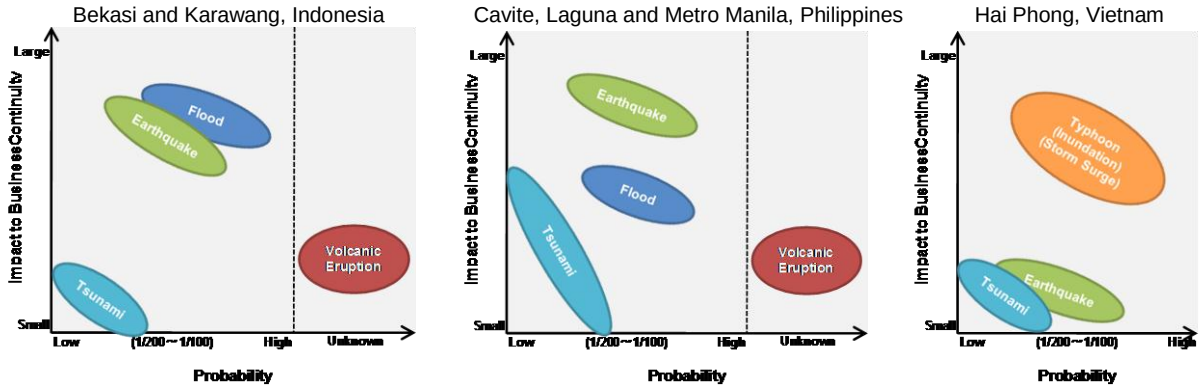

Figure 4. Dominant natural hazards and probabilities in the pilot areas

In this paper, as an example among the multiple hazard simulation outputs, we illustrate a simulation result of the Storm Surge and Rainfall event in Hai Phong, which is supposed to occur at high tide condition under the worst case typhoon track. Expected rain fall is 565mm/day, the probability of which is 0.5 to 1.0% approximately.

Figure 5 indicate that in the prospect, some part of the industry area will be inundated by 1m depth, which continues for several days. It seems not severe disaster in terms of water depth but if analyzed with the vulnerability of External Resources for business continuation, we can prospect following impact scenario:

- Buildings of factories in Industrial parks along the coast suffer inundation by storm surge.
- Hai Phong Power Plant is inundated with 0.5 ～ 1m depth. Electric power to Hai Phong area is limited.
- 220kV substation in Dinh Vu is severely damaged by seawater.
- 110kV substation near the coast suffers damage by seawater.
- Some of base stations of telephone/ mobile phone stop their operation due to the power shortage.
- Dinh Vu Port will be affected by storm surge.
- Cargo handling equipment of Dinh Vu Port is damaged by seawater.
- Container yard in Dinh Vu area will stop its operation.
- Some of the roads in the city will be closed for several days.
- Some of employee of factories will be absent because of the inundation of their houses.
- The traffic condition in Hai Phong becomes worse.

Identifying the critical business resources such as electricity and considering limitations of BCP at individual level, the participants to the pilot project recognized the risks of business interruption. They have then been discussing how they can recover the weakness of the area and seeking 1) Direction of approaches as the Industrial Agglomerated Area and 2) Necessary plan of Area BCM and actions to be taken by both parties of private and public sectors. Further, some participants try to establish their own BCPs in realizing the importance of preparing BCP.

The applied process of Area BCM system gives opportunities for participants to draft balanced measures from the categorized approaches of 1) Strengthening existing capacity, 2) Preparing alternative measures and 3) Making temporary back-up. The method of practice on these measures will vary from 1) Cooperation and share with other stakeholders, 2) Making new investment and 3) Transferring the risk.

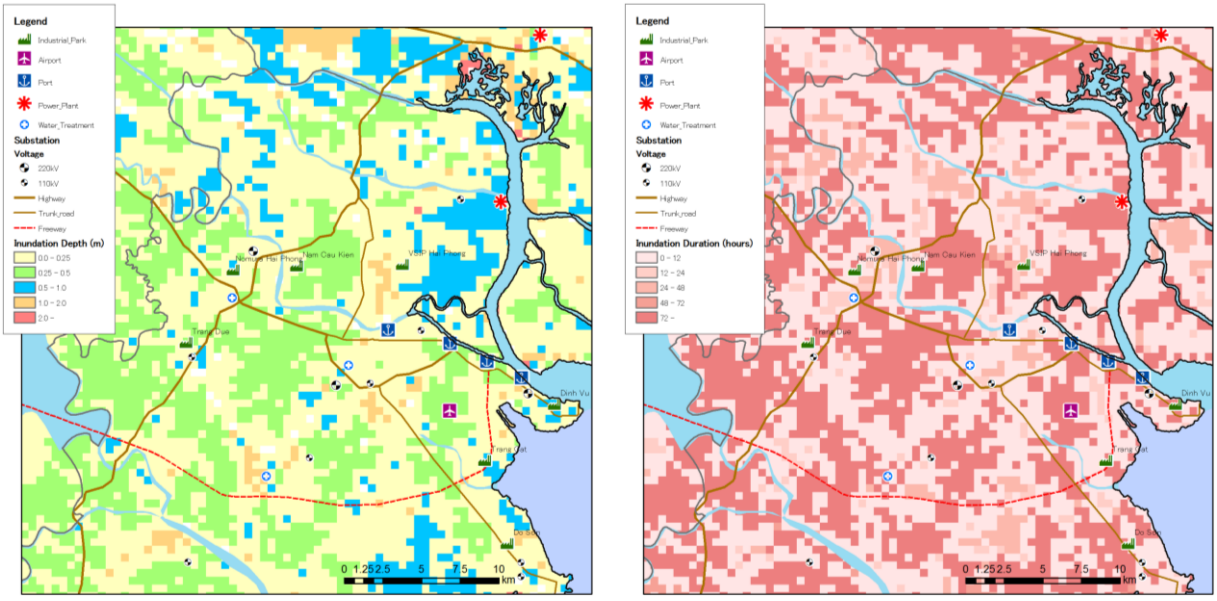

Figure 5. Simulated Inundation Depth (left) and its Duration (right), Hai Phong, Vietnam

6. BENEFITS OF THE AREA BCM

Area BCM unifies the efforts of stakeholders of the area, directs them toward a common goal, and allows the area to achieve restoration and reconstruction quickly, efficiently and effectively. Through the selection of measures, for example, the applied method made each Business Continuity Manager consider how to secure the availability of business resources and to cooperate with other partners by sharing the information among working group and clients of each enterprise through enhanced communication. Also, these considerations promote expanded coordination with other industrial agglomerated areas and other strategically critical areas. Coordination through supply chain is also enhanced by preparing alternative supply chain network.

Each organization's effort is geared up due to increasing responsibility under the coordination of the Area BCM. Even a company who had no BCP/BCM yet may start to prepare its own BCP/BCM.

Moreover, cross industries cooperation by Area BCP/BCM can further promote the cooperation among line industry. It automatically distributes the concept of the Area BCM to other areas.

Another benefit of Area BCP/BCM is that private companies may generate incentive to prepare plans for actions in various stages of Disaster Management Cycle (prevention and mitigation; preparedness and response; restoration and rehabilitation), while they tend to prepare the plans for only response issues due to their financial constraints and lack of capacity. After participating to the coordination framework, the private parties will be involved more deeply in difficult tasks, structural measures for example, while public sector is also encouraged to invest more robust infrastructure.

Since regeneration of local jobs, reconstruction of people's living environment and normalization of socio-economic activities are essential for the earliest rehabilitation of the locality, it is important for both public and private parties to enhance the capability as an area corresponding to disasters. Linking individual efforts of companies with public organizations, the opportunities under the Area BCM will vitalize the strategic operation even in normal business to avoid any threats and eventually contribute to disaster prevention as well as sustainable growth of all concerned parties.

Although it is premature to evaluate the total benefit of the pilot areas of the Area BCM, the increased resilience of the area would reflect to the asset value as for investment environment which could further pull down the disaster insurance cost of enterprises. If the reduction follows, it will attract more investment to the industry area. Enhanced continuity of the business in the area as a result could help develop the local economy and promote employment, which may have huge impact to the nation.

7. FURTHER CHALLENGERS

Major challenge to promote establishing the Area BCP/BCM is the coordination among stakeholders. Area BCP/BCM requires as much participation as possible from all the parties concerned, however, it is hard to get their involvement from the beginning without any incentives. The project we mentioned was initiated by JICA and the project team worked as a facilitator to promote Area BCP/BCM. In general, however, somebody has to take a lead and ask all the parties concerned to join the discussion on unknown new conceptual system. We need to carefully study and analyze each culture and existing customs of target area to start applying Area BCP/BCM and try to create accustomed Area BCP/BCM to the local traits.

Another challenge is the difference between the geological scale of the Area BCM and the area affected by actual disaster, which we cannot predetermine. As already mentioned, the geographical scope of the Area BCP depends on local situation or the size of stakeholder's coordination, and they can start and formulate Area BCP with specific target scale on specific disaster scenario. Initial Area BCP will be revised and improved through Area BCM to enhance the resiliency of the target area. Once visible output is made, some others may have an interest to join the group and forcing to expand the target area, and vice versa.

We are filing the processes of risk assessment and the Area BCP/BCM formulation adopted in the study for preparing guidelines which can be applied to the other industrial areas, and to any urban development similarly.

8. ACKNOWLEDGEMENT

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