INPUT PAPER

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AREA WIDE SCALE PARTICIPATION OF ALL PRIVATE AND PUBLIC SECTORS IN DISASTER RISK MANAGEMENT

"Area Business Continuity Management", Scalable Cross Sector Coordination Framework of Disaster Management for Business Continuity, to minimize local to global economic impact

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1 Newly arising issues since the adoption of HFA

When we appraise what has occurred in respective spheres since the adoption of HFA, despite the efforts of saving lives and successful disaster responses that reduced the number of casualty in many cases by laudable practices of improved preparedness, economic damages and losses are remarkably increasing and impacting to local societies and the globe.

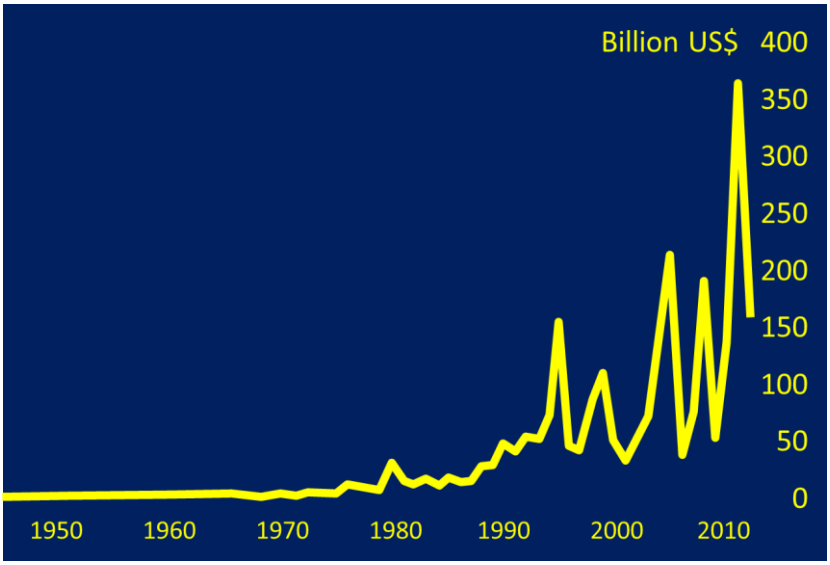


Chart 1 : Global economic loss of disaster. Source: EMDAT

While a disaster primarily causes damages on local economy, as industries are connected by supply chains and trading networks, the damage affects beyond boarders. And its impact may spread throughout the world.

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

The 2011 Flood of Chao Phraya River in Thailand again was a further reminder of the risks of business disruptions, with impacts on national, regional and global economies through their supply chains (Komori et al. 2012). The flooding for long periods of time caused heavy losses to the industrial sector. The seven industrial estates near Ayutthaya province, where a number of enterprises including Japanese firms are located, have been ravaged for more than a month by the flood started in October 2011. The destruction of Ayutthaya Province had a severe impact on the global economy through supply chains, especially in the automotive and electronics industries. According to J.P. Morgan (2011), the event set back global industrial production by around 2.5%. Its aftermath continued for long period of time - for months or years in the case of some of the companies and products (METI 2012).

In the above catastrophes, some industrial agglomerated areas had significant impact on the local economy, employment and population outflow, and the socio-economic change spread throughout the nation. After the events, the local and national governments are still challenging for early regeneration of local industry which is essential for reconstruction of people's living environment and normalization of socio-economic activities in rehabilitation and reconstruction phase.

On the other hand, improvement of area-wide economic resilience to disaster, as ex-ante, is a key issue for a local government, also for a nation. At the same time, the private sector's participation in area-wide disaster risk reduction initiative is also definitely one of the newly arising agenda we need to discuss.

The previous HFA however didn't make intense discussion on the area-wide economic resilience by private sector's participation.

Image 1 : Flooding of Rojana Industrial Park, Ayutthaya, October 2011

The flood caused extensive damage to the manufacturing industry. Source: Defense Video & Imagery Distribution System: III Marine Expeditionary Force / Marine Corps Installation Pacific. Author: U.S. Marine Corps. Photo by Cpl. Robert J. Maurer, Date: 16 October 2011

1-1 Highlighted private sector's role

On 21-23 May 2013, the Fourth Session of the Global Platform for Disaster Risk Reduction (GPDRR, organized by UNISDR) was held in Geneva. It was the first ever occasion where the Chair's Summary highlighted the importance of private sector's intervention in DRR.

The Summary, entitled "Resilient People, Resilient Planet", describes the above point of discussion, among eight highlighted issues, using the following words:

Recognizing the private sector as actor and partner: Steering private investment towards greater resilience makes good business sense. The private sector recognizes that it

has a crucial role to play in preventing and reducing disaster risk since businesses are not only exposed to natural hazards, but also often contribute to increased disaster risk in the process of driving economic growth. Indeed, resilient business and investment go hand in hand with resilient societies, ecosystems and the health and safety of employees. The private sector is progressively aligning its risk reduction efforts with the Hyogo Framework for Action and is developing business practices that promote resilience and foster new opportunities for public-private partnerships as part of an overall improved risk governance (GPDRR, 2013).

To follow up the Chair's Summary, the "Guidance on HFA Core Indicators Thematic Research" was issued, indicating the summary information consisting of 16 Thematic Research Areas to preliminary develop the input papers to the successor to the HFA.

Among others, in addition to the 13 retrospective review areas, the three emerging research areas are identified as:

Thematic Research Area 14: Private Investment in Disaster Risk Management (DRM).

Thematic Research Area 15: Standards and Normative Mechanisms for Disaster Risk Management.

Thematic Research Area 16: Interconnected Risk

Both the Private Investment in DRM (TRA 14) and the Interconnected Risk (TRA16) addresses the business investment practices which have been highlighted since the adoption of HFA and have interactions with any development interventions and the factors that mediate those interactions which have been examined through recent events.

The Idea is come up from an understanding that increasing disaster risks represent a growing problem for the economic and business community and business investments that aimed to strengthen competitiveness and productivity may have paradoxically and inadvertently contributed to increasing risk. Economic globalisation has enabled critical gains in business productivity and efficiency, but those gains have been at the expense of an over accumulation of disaster risk in many business locations and in the global economy as a whole. Private sector's role thus comes to be important for tackling with this paradox.

Like the HFA, the previous research and literature however has concentrated on the role of governments, communities and households rather than of businesses. Many of these risks and costs are externalised, transferred to and shared with governments, society at large and future generations. Losses to public infrastructure and services, to the workforce and to ecosystems also ultimately threaten the sustainability of all businesses and thus become a shared risk.

By investing in disaster risk management, businesses can reduce interruption represented by disaster losses and impacts and can save the business costs at the end. Cooperation between private and public sectors can also make the effective management of disaster risks in locality. The private sector can also promote corporate sustainability and shareholder value by leveraging operational business strategies, through such as redundant supply chain management and business continuity management.

The HFA2 should therefore reflect on the role and diversity of private sector engagement in reducing risk and building resilience and, more specifically, clearly identify and reflect a commonly understood coordination framework with other stakeholders and management mechanism.

The Interconnected Risk is also newly arising agenda focusing on the interdependence between business competitiveness, sustainability and resilience and governments' ability to manage disaster risk in local and national levels. Governments depend on business investment to generate employment and public wealth. Likewise, businesses depend on reliable public infrastructure, utilities and educated and healthy workforce, for efficient business operations.

Interaction between the risk management of public sector and that of private sector can be represented by local disaster management plan that designate the roles of public organizations to secure the safety level of infrastructure and utilities for sustaining community lives and businesses and in turn, the role of private sector to secure the worker's safe environment and resilient local economy. In addition, the private sector is expected to participate to inclusive coordination system of resilient society by sharing disaster relevant resources and information not only as a partner but also as an actor.

1-2 What we learned from recent catastrophes

Once a natural disaster has hampered or damaged a business, it self-evident that a certain amount of time will be required for that business to recover and to return to a level of production sufficient for trading to take place. The recovery process may be disrupted due to the loss and lack of business resources such as personnel, machinery, electricity, gas and water. Other indirect effects may include increased expenses, lack of demand, short-term loss of market share, travel difficulties, involvement in recovery operations, loss of production efficiency, loss of supplies, withdrawal of licenses, as well as loss of quality accreditation or approved standards. For many businesses, these impacts can be catastrophic.

The most significant contribution by the private sector for economic resilience has been the development of business continuity plan/planning (BCP) or the business continuity management (BCM) system (BCMS). BCMs refer to any effort that aims to achieve business continuity by engaging in whatever is considered necessary to protect a company's production, information, equipment, and employees. The BCP or BCM systems are standardized as ISO22301 (ISO, 2012) and disseminated through many business enterprises around the world.

Business Continuity Plan or BCP is a documented plan which describes methods and means to continue or quickly recover "Core businesses" (high priority business operation) under the emergency situation as well as preparatory actions by each subjective enterprise (Chart 2). BCP describes tactics to minimize the above mentioned loss and lack of business resources in an emergency (Ministry of Economy, Trade and Industry, Japan. 2012).

BCM then is a framework for identifying an organization's risk of exposure to internal and external threats. The goal of BCM is to provide the organization with the ability to effectively respond to threats such as natural disasters or data breaches and protect the business interests of the organization.

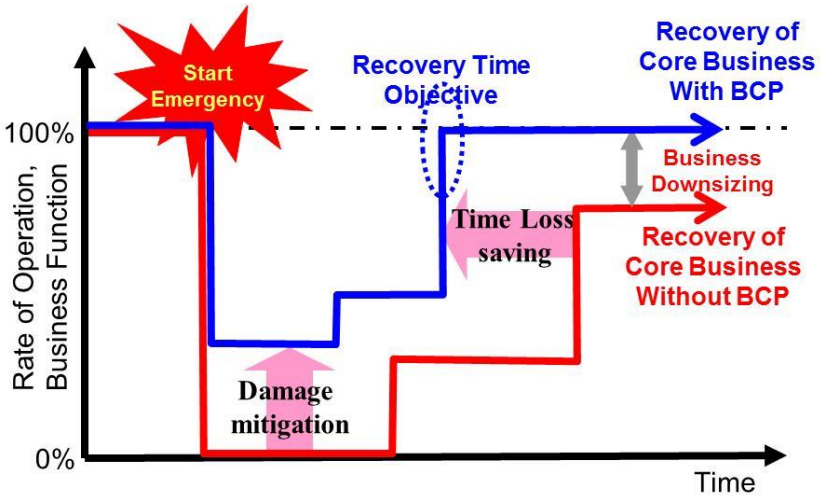


Chart 2 : Concept of Business Continuity Plan (BCP).

According to ISO 22301, a BCM system emphasizes the importance of:
- Understanding continuity and preparedness needs, as well as the necessity for establishing BCM policy and objectives.
- Implementing and operating controls and measures for managing an organization's overall continuity risks.
- Monitoring and reviewing the performance and effectiveness of the business continuity management system.
- Continual improvement based on objective measurements.

A BCP or BCM is however designed to be a single organization's internal document and framework. It simply seeks to protect an organization's profits from the risk of exposure to internal and external threats. The purpose of the system in private companies, as mentioned in the standard guides, can be considered as being 'competitive' with other companies, rather than 'cooperative' in the locality where the company operates. Another limitation of the BCP/BCM is that the assumption of the threats is rather more vague than scientific. It normally starts from considering how to mitigate the 'business impact' caused by any unspecified threat of disaster, accident, power or energy disruption, lifeline service failure, terror or cyber-attacks, etc. The process is nebulous, because organizations seldom have the ability to analyze the threat, hazard or assess the area-wide impacts of it. The prospect of a severe accident, such as total devastation of the power network in wide area for a long period following a large-scale disaster, for example, is normally beyond the scope of analysis.

The climate change, rapid urbanization, industrial agglomeration and uncontrolled development are some factors promoting disaster damages and losses. The private sector's role in DRM through the effort of business continuation should also be adaptable to those uncertain but plausible factors of disaster risks.

The limitations of conventional BCPs or BCM systems were really self-evident following the Great East Japan Earthquake and the flood of the Chao Phraya River in Thailand (Okada 2011). Some prearranged BCPs/BCMs in private enterprises helped them survive to some extent but overall, the plans failed to provide a sufficient basis for continuation of business or quick recovery from damage (Sato and Bessho 2011). This was due mainly to disruption of area-wide installed common resources such as energy, water, transportation and communications that are essential for business operations (Special Study Team 2011).

With this circumstances, it is expected to develop a new guidance as to how this might be more effectively represented in the successor framework to the HFA.

Image 2 : Industry depending on local infrastructure.
Source: ChiefHira, Internet, 7 June 2011

2 Area Business Continuity Management (Area BCM), a new opportunity for improving economic resilience

Based on the background, Japan International Cooperation Agency (JICA) developed a new concept of Area Business Continuity Plan (Area BCP) and Area Business Continuity Management (Area BCM) to improve the continuity in the local economy in times of disaster. The feasibility of the concept was tested and confirmed in a study entitled "Natural Disaster Risk Assessment and Area Business Continuity Plan Formulation for Industrial Agglomerated Areas in the ASEAN Region", which JICA launched in February 2013 in collaboration with the ASEAN Coordination Centre for Humanitarian Assistance (AHA Centre) (Baba et al. 2013). Area BCP/BCM refers to the efforts of an area that aims to prevent economic stagnation of the targeted area regardless of the circumstances. To achieve this goal, cooperation between the private sector, national government, municipalities, operators of infrastructure and utilities in the area is necessary. Area BCM also requires a process of scientific assessment, as a part of the management cycle, in order to develop a common understanding of risks and impacts in the area which should be based on a multi-hazard, multi-scenario and probabilistic analysis. The initiative intends to strengthen the resilience of local economies, as well as regional and ultimately global economies.

2-1 Internal and External Resources for business operation

When a large-scale flood strikes, inundating entire areas, it has the potential to cause major damage to factories. In that case, companies and industrial parks must repair and replace damaged machinery to restart operations. However, their business cannot be re-established solely through a company's efforts. For a company to continue its business, restoration of public infrastructure such as power supplies, water supplies, roads, ports, airports is essential.

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,

Analysing the causes of operation cessation 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 raw materials, are under the control of each enterprise. External resources, on the other hand, such as energy, water and transportation infrastructures, are normally managed by the public sector and not under the control of private enterprises. External resources are also distributed not only for business purposes but also for securing community life. Therefore, following emergencies, limitations on the allocation of those resources may be imposed. In such cases, collaborative efforts may be required between the private sector, public sector and the local community.

The absence of some external resources can result in common bottlenecks for effective business continuity across a wide area following a disaster. Disruption of transportation systems, for example, could force all companies to stop delivery of products and parts. It also may lead to situations where workers and staff become stranded in the place they were when the event occurred. If the recovery process is lengthy, and they are unable to commute back home, the area may suffer difficulties resulting from the lack of food, water, accommodation and a safe environment for the workers. However, if area-wide measures for stranded people have been prepared by the public sector or by some major enterprises, they can effectively solve the problem through area-wide coordination.

2-2 Concept of "Area BCP" and "Area BCM"

The term 'Area BCP' has been derived from 'Area Command', an organizational structure designated under the National Incident Management System (NIMS) of the Federal Emergency Management Agency (FEMA) in the United States (Waugh 2009) (Figure 1). Area command is used to oversee the management of multiple incidents or a very large incident that requires multiple incident command systems (ICS) or management teams to establish critical resource-use priorities between various incidents and to coordinate disaster management actions. ICS is a subcomponent of the NIMS, as established by the U.S. Department of Homeland Security in 2004. It was designed to give standard response and operation procedures to reduce the problems and potential for miscommunication during incidents.

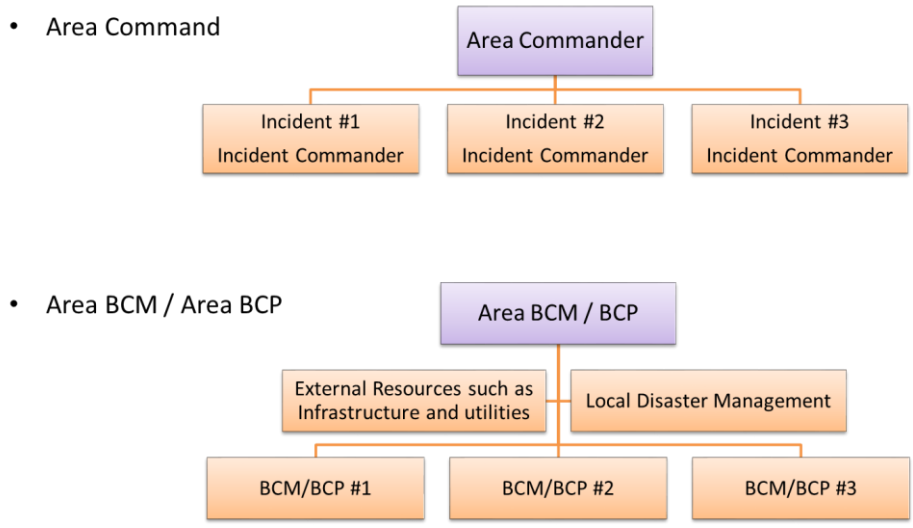


Figure 1 : Area Command of ICS and Area BCM / Area BCP.

As definition, the Area BCM is a cyclic process of understanding risks and impacts, determining common strategy of risk management, developing the Area BCP, implementing the planned actions and monitoring to continuously improve the Area BCM System, in coordination among stakeholders including individual enterprises, industrial area managers, local authorities and administrator of the infrastructures as well as communities, in order to improve the resilience of local economy to disasters (Figure 2).

Area BCP then designates a framework and direction of coordinated damage mitigation measures and recovery actions of stakeholders in order for business continuation of the industrial area as a whole.

Figure 2 : Area BCM Cycle.

Since the term and concept of the 'Area Command' has already been adopted by many countries, including the U.S., and following the spatial scope of emergency management that 'area' indicates, our definition of the new concept uses the same term to designate a framework and direction of area-wide disaster management as above. Similarly to the Area Command in terms of management scale, the Area BCP coordinates multiple BCPs by different enterprises in the affected area. As a point of comparison, management of external resources and relevant coordinated actions of disaster management should be conducted under the coordination of the Area BCP.

2-3 Area BCM and Local Disaster Management (ICS)

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 be reduced in response to the scale of disaster impacts and the operational situation. In practice, it is difficult to predetermine the size of an area with a changing and uncertain disaster occurrence. As with Area Command, the affected area size and levels of emergency depend on the magnitude of the disaster. Therefore, the coordination structure of Area BCM should be organized in such a way as to expand as needed based on the prospective damage, the availability of critical resources and changing hazards. Coordination hubs should be established with the most important and authoritative positions of local and national government as well as the management organization of an industrial cluster. In this command structure, the 'multi-stakeholder risk management system', which is one aspect of the Area BCM, may normally involve serious conflicts of interests among stakeholders. Therefore, preparation of a conflict management policy is also necessary.

The maximum size of the coordination of an Area BCM should not exceed the scale of local disaster management (ICS) that will be required to oversee not only the business continuity but also work for the benefit of the whole society (Figure 3). The geographical scope of a particular Area BCP, however, depends on local conditions or the size of a stakeholder's coordination area, so that an industrial park, an industrial agglomerated area or even a nation can be its scope.

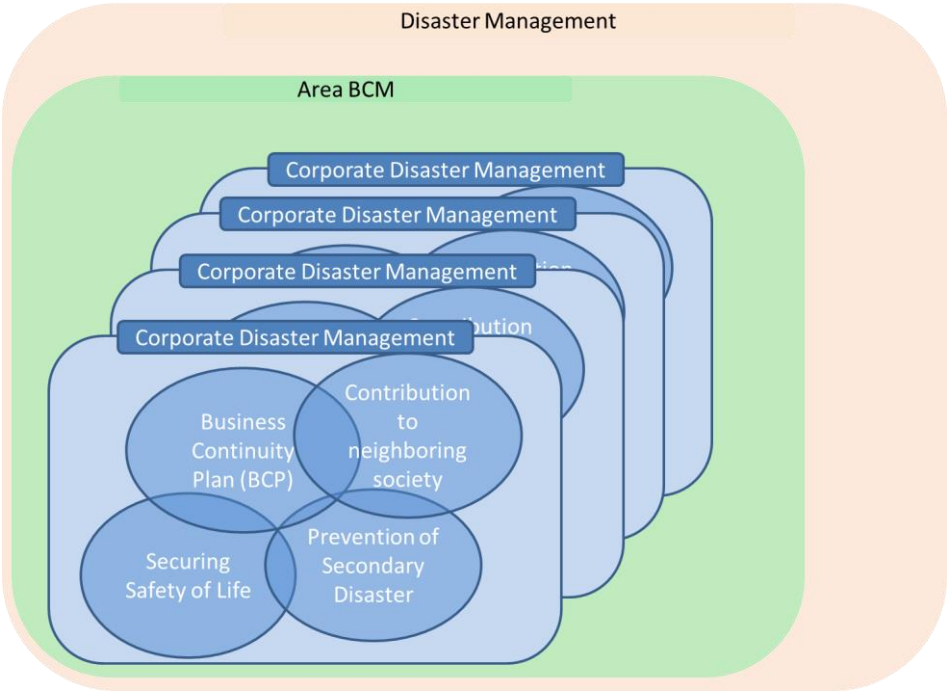


Figure 3 : Corporate Disaster Management, Area BCM and Local Disaster Management.

2-4 Interactive function of BCP/BCM and Area BCP/Area BCM

While the BCP is designed to prevent the company's core business from being suspended in emergency circumstances, the aim of an Area BCP/BCM is to secure the critical external

resources that are essential in supporting business operations in and around the industrial agglomerated area. Through the process of an Area BCM, which will be discussed later, the existing disaster management capacity of each enterprise or organization, including documented BCP, formulated BCMS or any disaster relevant system, will be examined in order to analyze the vulnerability of the area. Through a process of reviewing and coordinating all the stakeholder's BCPs, Area BCPs can contribute to the measures to address the issues revealed, as well as clarifying the roles of the various stakeholders. Area BCP/BCMs promote an area-sensitive standardized coordinated management system as well as bolstering resilient businesses by enhancing the relationships between them. In this sense, the functions of the BCP/BCM and the Area BCP/BCM can be interactively coordinated. The plan of activities of both systems should be reflected in each other when reviewed.

Functions of the BCP/BCM and the Area BCP/BCM is interactively coordinated. The plan of activities of both systems should be reflected each other when reviewed. Table 2 explains the relations between individual BCP/BCM, Area BCP/Area BCM and provides a plan for local disaster management.

Table 2 : BCP/BCM, Area BCP/Area BCM and Local Disaster Management.

	BCP / BCM	Area BCP / Area BCM	Local Disaster Management
Objectives	Protect enterprise from losing customers, market share and corporate value by disruption of core business.	Minimize economic damages or losses of an industrial agglomerated area as a whole by cooperating efforts of stakeholders to secure common business resources. (Critical External Resources in particular)	Reduce disaster risks or damages through systematic efforts of effective measures by national and local organizations, and awareness and responses for disasters by community and residents.
Plan	Documented procedures that guide organization to respond, recover, resume and restore to a pre-defined level of operation following the disruption.	Document that describes 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 the industrial area as a whole	Document prepared by an authority, sector, organization or enterprise that sets out goals and specific objectives for reducing disaster risks together with related actions to accomplish these objectives. (2009 UNISDR Terminology on DRR)
Coordination	Separately by: private enterprises, national and local authorities, emergency responders, infrastructure and utility operators	Local authority where the industry agglomeration area is located. National authority of DM and that of industry and economy, Management organization of an industrial cluster.	National and Local authorities, sector, organization or enterprise, operator of infrastructure and utilities, community and others

2-5 Cooperation of Stakeholders of Area BCM

The Area BCM, as defined, requires participation from both the private and public sectors, the members of which are involved in various kinds of businesses or services in the focus area. Other important stakeholders include not only private enterprises but also industrial park managers, municipal workers and administration, as well as public service and utility providers. The coordination and cooperation of stakeholders is the key to a successful Area BCM.

There are different types of cooperation (Figure 4). The most simple form entails cooperation between multiple enterprises in an industry-agglomerated area that can share critical business resources by linking each BCP/BCM with any system of emergency operation. Public-private cooperation is an extended arrangement of shared roles in area-sensitive disaster management, where the public sector plays a role mainly as coordinator while the private sector becomes the implementer. The public sector also takes on the important role of distributing risk information and securing the function of infrastructure resources for the area. Inter-regional cooperation with other areas of industry is another mode of cooperation. It can provide the affected area with a temporary backup supply of necessary business resources. It may be beneficial to prepare partnering arrangements between regions as part of each Area BCP. Cooperation through chain industry networks, such as major automotive groups, can also be effective. Normally such major companies have BCPs that consider various scenarios of supporting line companies. Area BCPs should link with this industry chain cooperation.

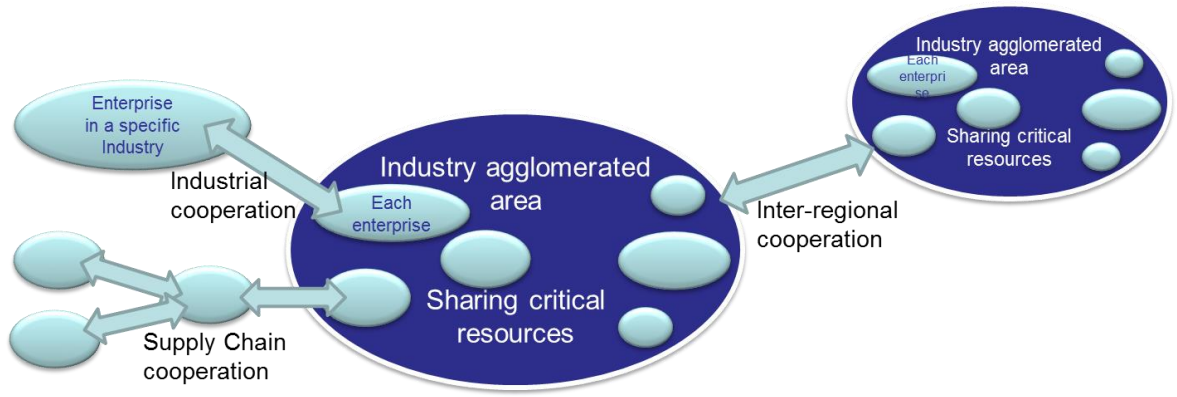


Figure 4 : Different means of cooperation under Area BCM

In the case of the Great East Japan Earthquake, where supply chains were negatively affected even far outside the disaster area, there was significant disruption of production parts delivery (Saito 2012). Ota (2011), however, found that supply chain cooperation could provide an effective alternative, as businesses could quickly establish replacement delivery networks of essential parts or resources for production and operation. In order to benefit from this approach, we argue that it is also better to prepare or strengthen alternative supply chain networks in advance.

We also found that, in restoration and reconstruction activities, cooperation between the affected community and neighbouring enterprises in the region, or assistance from outside the affected areas, was an effective practice in order to generate private sector participation in disaster management. Local governments should promote support for this with a wider scope of BCPs in order to enhance cooperation (Kagiya and Isouchi 2009).

2-6 Process of the Area BCM

As defined above, the Area BCM must be conducted as a part of a continuous cycle of improving capacity of local resilience in the economy to disasters on an area-wide scale. To meet this, the management process must be designed in a way that incorporates fundamental issues, Area BCP formulation and management concerns, as Figure 5 illustrates.

The first step of developing an Area BCM is that private companies, local governments, infrastructure and utility operators should sit down together. The size of the area should be determined based on the interest of organized stakeholders, who should have a common understanding of the potential weaknesses of the area in times of disaster. In the process meetings, the stakeholders should work to identify possible bottlenecks that may lead to the disruption of business, and generate measures that will lead to a plan for business continuity of the area. Measures that are implemented can then be monitored and evaluated for better management of business continuity. The followings steps are the central components of the Area BCM Process.

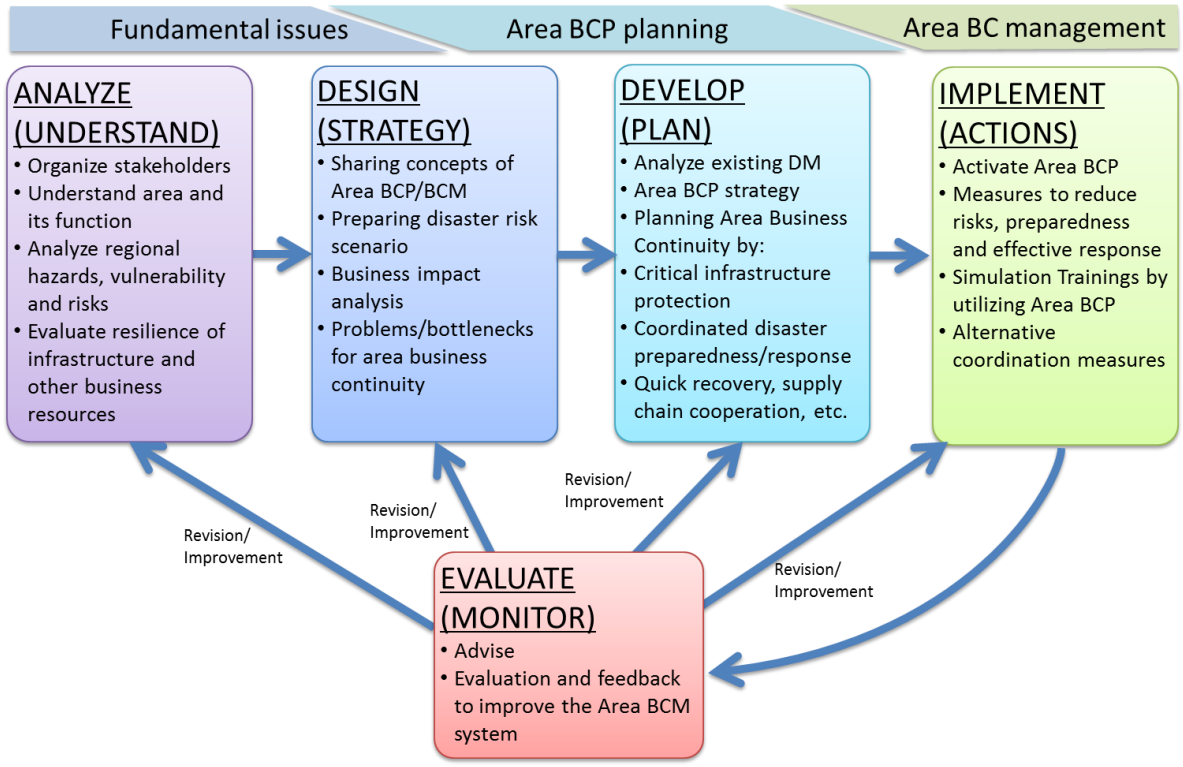


Figure 5 : Process of the Area BCM

2-6-1 Analysing and understanding the risks and impacts

In order to create common understanding of disaster risks and impacts among all parties involved in the Area BCM process, it is essential to have a scientific analysis of probable hazards, existing vulnerabilities and the resulting risks to business interruption. Ideally, the analysis should be based on a multi-hazard (natural, Na-tech, manmade), multi-scenario and probabilistic methodology. This would include the potential hazards based on an assessment of the probabilities of them occurring.

In order to prepare for risk scenarios in the target area, it is necessary to evaluate the disaster resilience of infrastructure and business resources as well as the current state of supply chains. Then the vulnerability and resilience of the elements related to the business continuity of the area can be assessed.

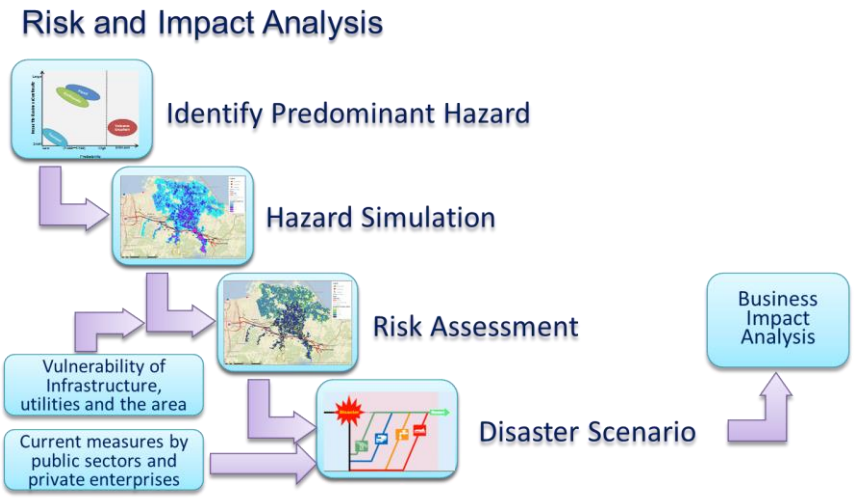


Figure 6 : Steps of Risk and Impact Analysis

2-6-2 Determining the Area BCM Strategy

The result of the above simulation and evaluation should be followed by a business impact analysis on an area-wide scale as well as within each of the participating organizations. Discussion of the impacts will then expose the problems and bottlenecks of the area. Creation of risk scenarios can provide the basis for discussing the risk management strategies, plans and measures by stakeholders as part of the next step. Through this process, as a regulated system of risk management, cooperation between various stakeholders is expected to strengthen.

2-6-3 Developing the Area BCP

This part of the process consists of analysing existing measures as well as the private sector BCPs for use in natural disasters, working to establish a strategy for Area BCP/BCM, and then formulating a plan for cooperation. The plan should include promoting infrastructure

development to increase resilience, co-ordinate disaster responses and establish procedures for monitoring the Area BCM activities to provide feedback.

The basic structure of the Area BCP is similar to the standard contents of ISO defined BCP as Figure 7. Although the first experimental application of the Area BCM system in the three ASEAN industrial agglomerations is still in a stage of formulating the first version of the Area BCP, already some important lessons have been output.

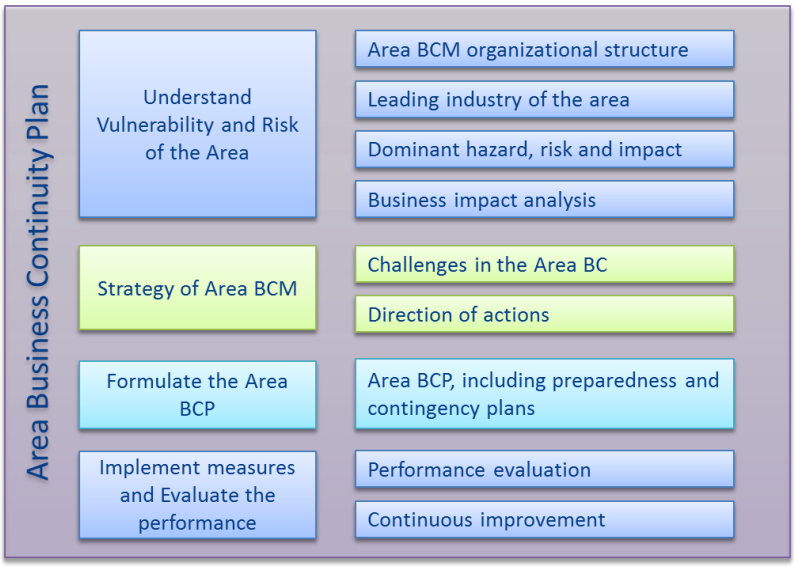


Figure 7 : Basic structure of the Area BCP

2-6-4 Implementing the planned measures

This part of the process includes developing preparedness for planned measures, simulation-based trainings, coordination activities and actual responses to any emergency. This is linked with the BCP/BCM of each 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 the private and public sectors but can start from small efforts. At the very least, it can include activities such as information sharing and promotion of disaster risk reduction actions to the extent that this is possible.

2-6-5 Monitoring and feedback

Evaluation and feedback of the process is always important. In the Area BCM, monitoring should be designed to provide advisory feedback on all the steps of the Area BCM cycle through discussions among the stakeholders. A variety of scenarios based on differential hazards should also be targeted in the continuous process of Area BCM development.

3 Case Study of the Area BCM Application

This section introduces a case study of three pilot areas among ASEAN nations that were selected for the JICA project on the application of the Area BCP/BCM.

3-1 Industry agglomeration in ASEAN nations

Triggered by direct investment, especially in the electricity and/or electronics industries, industrial agglomerated areas in many countries in Asia have made successful contributions to national development. The increasing inflows of foreign capital accompanied by high technologies has driven developers and local governments of industrial areas to further attract foreign-affiliated firms by providing special measures, such as establishing export processing zones (JMC 2000).

Industrial agglomeration generally tends to occur along coastal or riverine zones, which are convenient for physical distribution. The formation of industrial clusters in cities is also linked to the progress of urbanization, along with the concentration of workers, as one outcome of the increasing production (METI 2010). In ASEAN, the supply chain networks of these industrial clusters are also expanding within the region as ASEAN constantly develops, which further accelerates industrial agglomeration in and around recently developing cities. These newly developed locations, however, tend to be vulnerable to floods, typhoons, storm surges and other natural hazards. Earthquakes, tsunamis and volcanic hazards are also significant in some Asian nations along the Pacific Rim.

One indicator of these vulnerabilities was the 2011 flood in Thailand, which caused extensive damage over a wide range of areas, from the capital city of Bangkok to the North. Flooding over long periods of time caused heavy losses in the industrial sector. The seven industrial estates near Ayutthaya province, where a number of enterprises including Japanese firms are located, have been ravaged for more than a month by the flood started in October 2011. The destruction of Ayutthaya Province had a severe impact on the global economy through supply chains, especially in the automotive and electronics industries. According to J.P. Morgan (2011), the event set back global industrial production by around 2.5%. Its aftermath continued for long period of time – for months or years in the case of some of the companies and products (METI 2012).

Nowadays, areas of industry agglomeration in other ASEAN countries show vulnerability to the increasing incidence of disasters, such as floods, typhoons/cyclones, earthquake, tsunamis and others. In fact, East Asia is experiencing rapid industrialization and urbanization (Jha et al. 2012). Cities are becoming disaster hotspots (Dilley et al. 2005). Great numbers of people and most areas where economic activity occurs are vulnerable to natural disasters, as Figure *8* shows.

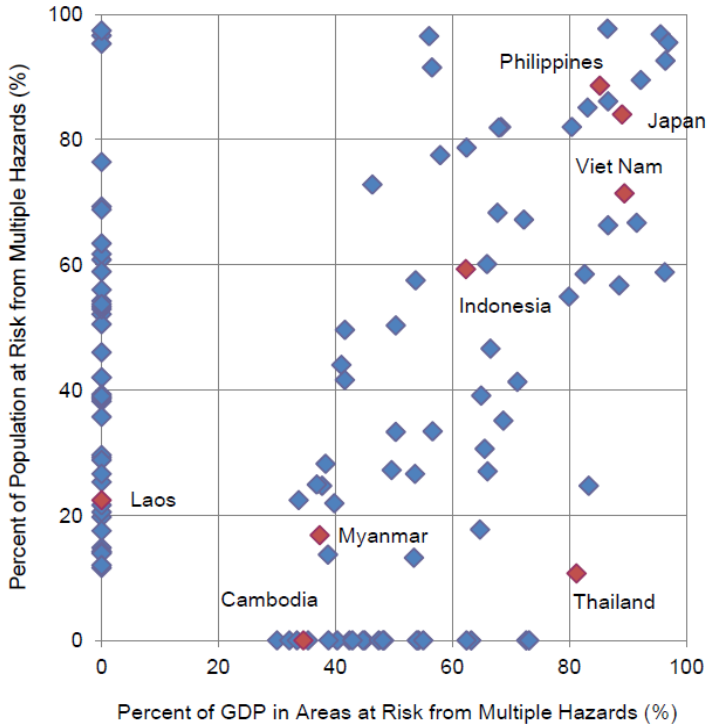


Figure 8 : Percentage of Population (vertical axes) and percent of GDP (horizontal axes) at risk from multiple hazards. Modified from Natural Disaster Hotspots, Global Risk Analysis, The World Bank (Dilley et al. 2005).

Considering the situation, JICA selected Indonesia, the Philippines and Vietnam, all of which belong to high risk countries among the ASEAN region, as countries for piloting the Area BCP/BCM formulation. In each country, Bekasi-Karawang industrial areas, Cavite-Laguna-Metro Manila and Hai Phong industrial areas, respectively, are specified for the target areas since they are highly agglomerated by various industries as well as exposed to the increasing risk of disasters, such as earthquakes, floods, tsunamis, typhoons/cyclones.

3-2 Probabilistic Hazard Analysis

Through the practical implementation of the pilot project, a standard method of Area BCP formulation was developed 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 and methods employed in hazard analysis should not be unnecessarily sophisticated or highly technical. Situations where basic data for analysis is lacking and limitations on financial capacity should also be considered.

Based on the above conditions, the elements (i.e. tools and software) of probabilistic hazard analysis applied in the pilot project were selected from widely used, easily handled and generally applicable ones as shown in Table 3.

Table 3 : 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

3-3 Identified dominant hazards

The project identified the dominant hazard in the industrial agglomerated area using probabilistic analysis of multiple hazards (Chart 3). Floods and earthquakes are the top two hazards in the Bekasi–Karawang area while earthquakes in Cavite-Laguna-Metro Manila and typhoons and storm surges in Hai Phong are considered the dominant hazard types.

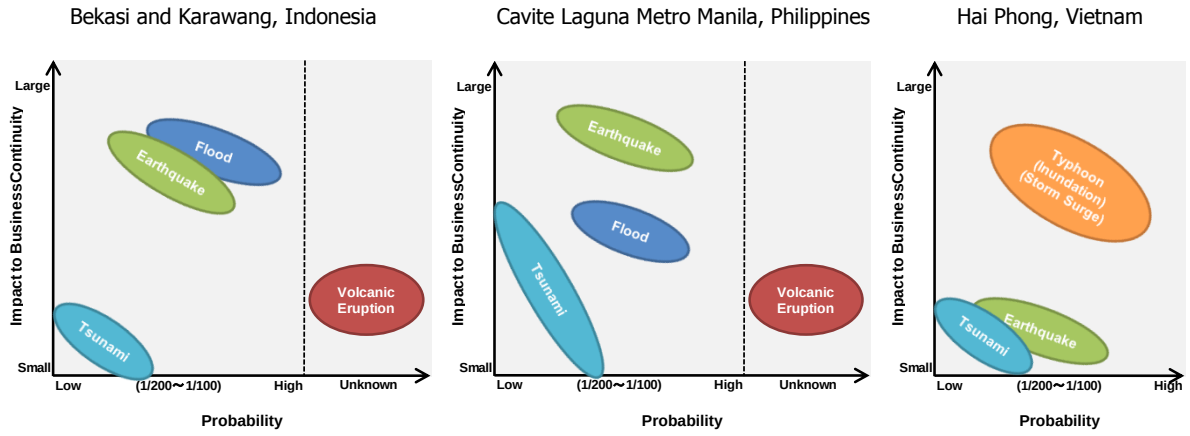


Chart 3 : Dominant natural hazards and probabilities in the pilot areas.

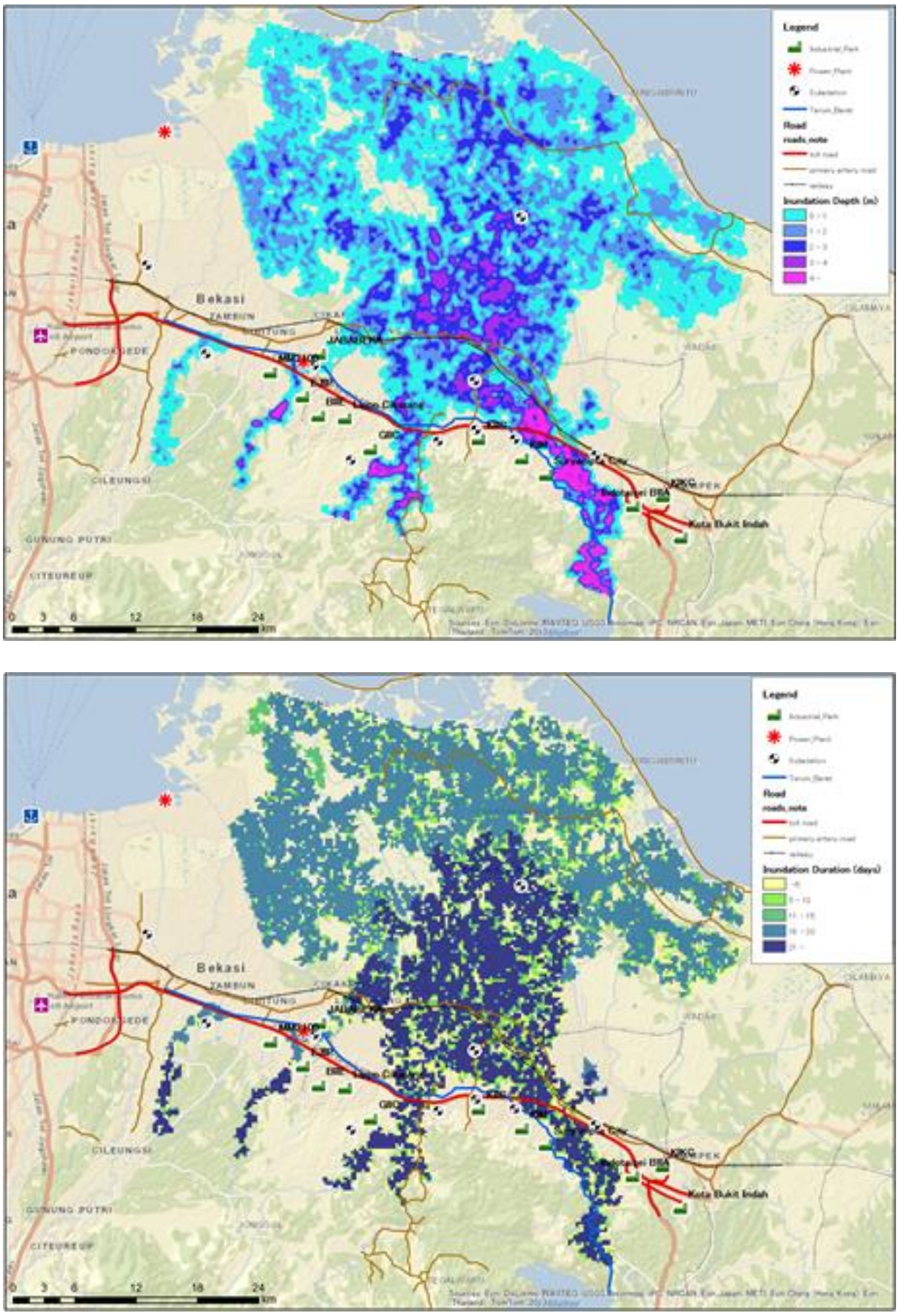
3-4 Disaster Risk Scenarios and Business Impacts

Disaster simulations were conducted to visualize the impact of the dominant hazards in each area, projecting severe cases of disaster, the probability of which is 0.5 to 1.0 %/year (100 to 200 years average return period probability).

3-4-1 Bekasi - Karawang industry area in Indonesia

Map 1 shows simulation result of the flood in the Bekasi–Karawang industrial area in Indonesia. In this case, some cities, sections of road networks, including the central highway and two electrical substations are inundated by flood. The industrial parks, however, are not

directly hit by the flood. Inundation depths at the most severely affected parts, such as the highway near a local city of Suryacipta, exceed over 4m for more than two weeks.



Map 1 : Simulated Flood Inundation (top) and its duration (bottom) in Bekasi – Karawang Industry Area, Indonesia.
Simulation Software: runoff model by IFAS, inundation model by iRIC.
under 0.5 to 1 % probability of heavy rainfall.

Based on the projected hazard and vulnerability analysis, the basic scenario was created as;

(1) Buildings in industrial park

- Karawang City and surrounding area is inundated for more than 2 weeks.
- Industrial parks, however, are not inundated, and facilities are not damaged.
(2) Electric power and lifelines
- Two substations in Karawang City are inundated to over 2m in depth and cease operations for two weeks.
- Some base stations of telephones and mobile phones cease operations because of the shortage of electrical power.
(3) Transportation infrastructure
- Freeway (Jakarta-Cikampek Toll Road) is closed both in the west and east of KIIC for more than 2 weeks.
- Primary Road in Karawang City is closed for more than 2 weeks.
(4) Workers at the industrial parks
- Many employees are absent because of the inundation of their houses.
- The traffic conditions become worse, inducing the workers to stay at home.
Since the Jakarta Port is the only one shipping stage used in this area for export/import the products and parts, the disruption of the transportation route to/from the port for days and weeks as above was assumed to hamper the production of factories that are locating eastern side of the inundation area. Also other factories could put down the operation because of workers absence or disability to commute.

3-4-2 Cavite - La-guna - Metro Manila in the Philippines

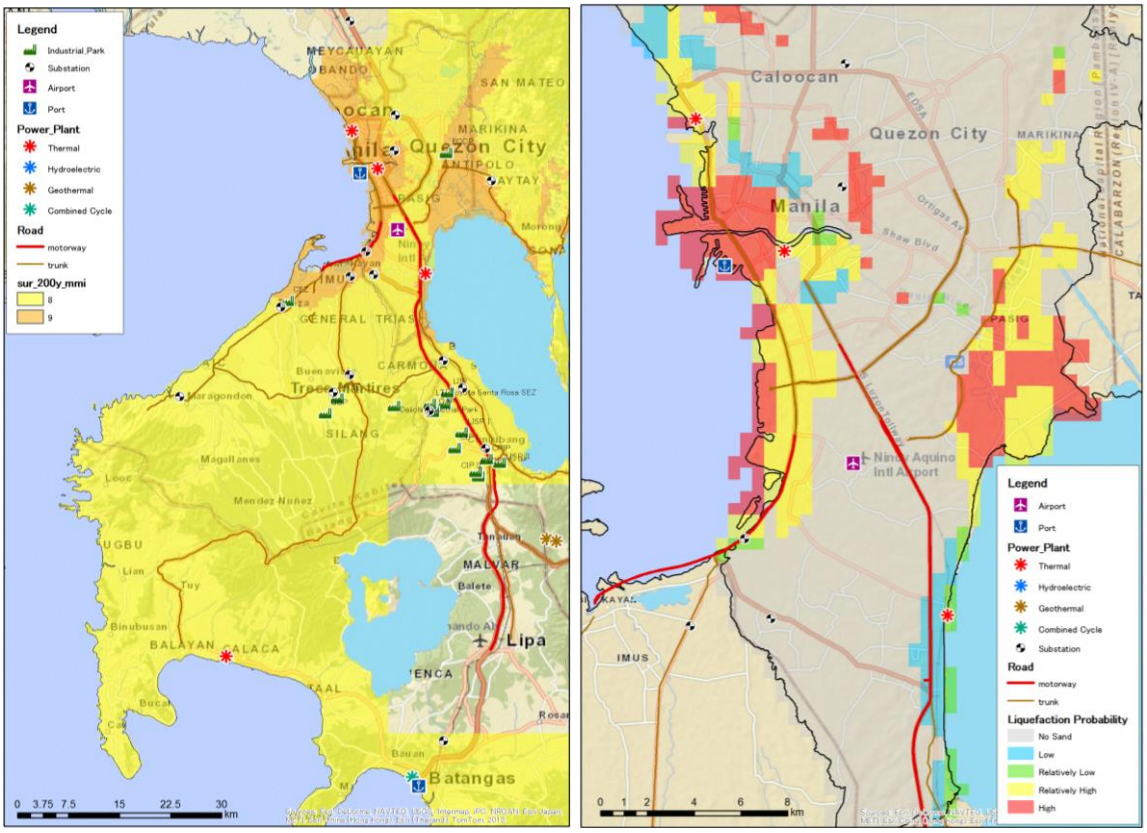
Map 2 shows the simulation results of an earthquake in Cavite-Laguna-Metro Manila in the Philippines, which is supposedly under the probability of once in 200 years, and the area at risk is 8~9 on the Modified Mercalli Intensity scale (MMI). The figure also indicates the high potential area of liquefaction along Manila Bay.

Based on the projected hazard and vulnerability analysis, business impacts were considered based on the following scenarios;
(1) Buildings in industrial parks
- 10% of the buildings suffer moderate damage. Repair is necessary.
- Some of ceiling panels and illuminators fall down. Part racks topple.
- Non-anchored machinery moves.
- Transformers topples.
(2) Electric power and lifelines
- The electricity substation stops the operation for one week. Capacity recovers to 50% one month later and it takes 3 months for full recovery.
- Wired phones and mobile phones become congested because of the shortage of electric power.
- Wells and water tanks cease operating for several days. Capacity recovers to 50% after one week and it takes one month for full recovery.
(3) Transportation infrastructure
- The expressway between Manila and Cavite is closed for 2 weeks because of the liquefaction. After temporary restoration work, limited traffic becomes possible.

- Traffic capacity of the Expressway between Manila and Laguna is limited in some sections. It takes one week for 50% recovery and 2 weeks for full recovery.
- Most piers of Manila Port are unable to be used for several months because of the liquefaction. Several piers become usable after temporary restoration work.
- In the container terminal, gantry cranes are severely damaged. It will take half year to recover 50% of the capacity for cargo handling.

(4) Workers at the industrial parks

- Some of employees are absent because 10% of their houses are heavily damaged, with a further 20% suffering moderate structure damage.
- The traffic condition becomes worse and they arrive late at the factory.



Map 2 : Simulated Earthquake Intensity (left) and Liquefaction Potential (right). Cavite, Laguna and Metro Manila, Philippines

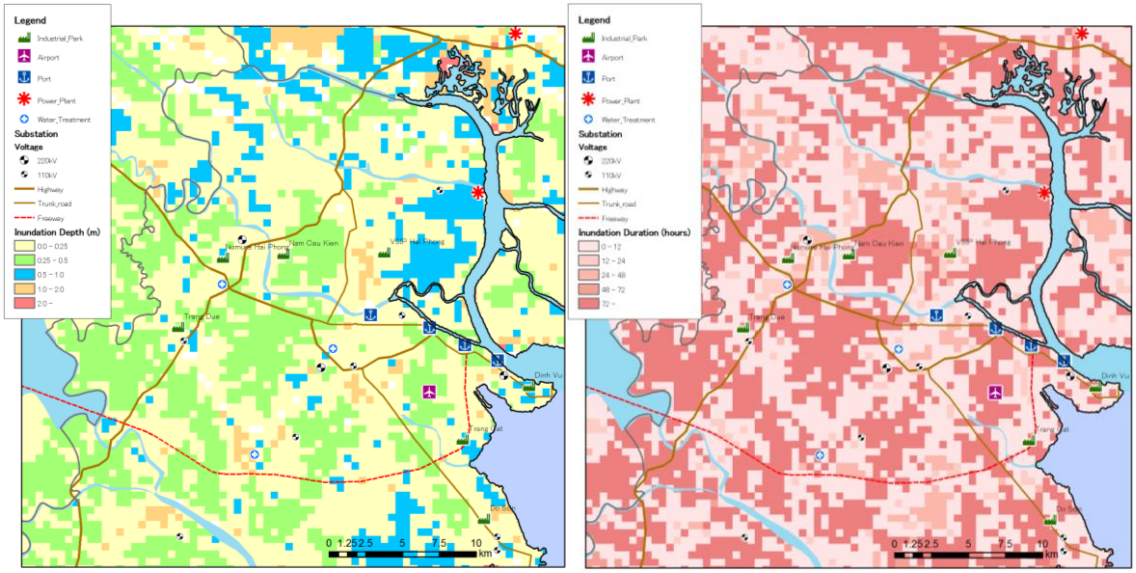
3-4-3 Hai Phong in Vietnam

Map 3 shows simulated results of the storm surge and rainfall event in Hai Phong, which is supposed to occur in high tide conditions under the worst-case typhoon track. Expected rainfall is 565mm/day, the probability of which is approximately 0.5 to 1.0%.

The map indicates that in the prospective areas, some parts of the industrial area will be inundated to 1m depth and this will continue for several days. While in terms of water depth it may not seem like a severe disaster, but if analyzed considering the vulnerability of

external resources necessary for business continuation, we can assume following impact scenario:

- Buildings of factories in industrial parks along the coast suffer inundation by the storm surge.
- Hai Phong Power Plant is inundated to 0.5–1m depth. Electric power to Hai Phong area is limited.
- The 220kV substation in Dinh Vu is severely damaged by seawater.
- The 110kV substation near the coast suffers damage from seawater.
- Some of base stations of telephone/mobiles phone cease operations due to the power shortage.
- Dinh Vu Port is affected by the storm surge.
- Cargo handling equipment of Dinh Vu Port is damaged by seawater.
- The container yard in Dinh Vu area ceases operations.
- Some of the roads in the city are closed for several days.
- Some employees of factories are absent because of the inundation of their houses.
- The traffic conditions in Hai Phong become worse.



Map 3 : Simulated Inundation Depth (left) and its Duration (right), Hai Phong, Vietnam

3-5 Area BCP Formulation

The discussions of participants for the pilot project in each area under the established framework of Area BCM were facilitated by the study team. A series of meetings and workshops were held to share information and improve knowledge needed to formulate the Area BCP. Sessions were structured to promote interaction between the consultant and the participants.

The information and knowledge sharing consisted of:

1) Hazards affecting the industrial agglomerated area,

2) Critical business resources in disaster situations,
3) Limitations of existing BCPs at the individual business level,
4) Impact of disasters on business operations,
5) Weaknesses or bottlenecks in the area and the effects on business continuity,
6) Strategies for the industrial agglomerated area as a whole, and
7) Steps necessary for planning of an Area BCM and the necessary actions to be taken both by private and public parties.

In the process of Area BCP formulation, all parties should have opportunities to select single or mixed measures considering the balanced combination of tactics: 1) strengthening existing area-wide capacity for risk reduction and damage mitigation through infrastructure improvement, for example, 2) preparing alternative measures, such as second lines of transportation, networking of power distribution and ground water extraction facilities, and 3) making temporary back-up systems, such as emergency batteries and temporary accommodation facilities.

The parties should also discuss schemes (or practical methods) of implementing those measures such as, 1) cooperation with other stakeholders to share essential resources for business continuation in the area, by controlling or adjusting the logistics flow on the congested transportation, for example, 2) making new investment for area-wide resilient development, by constructing common facilities for accommodation cum emergency operation, for example, and 3) transferring the risk, by mutual insurance or public compensation, for example. (Figure 9).

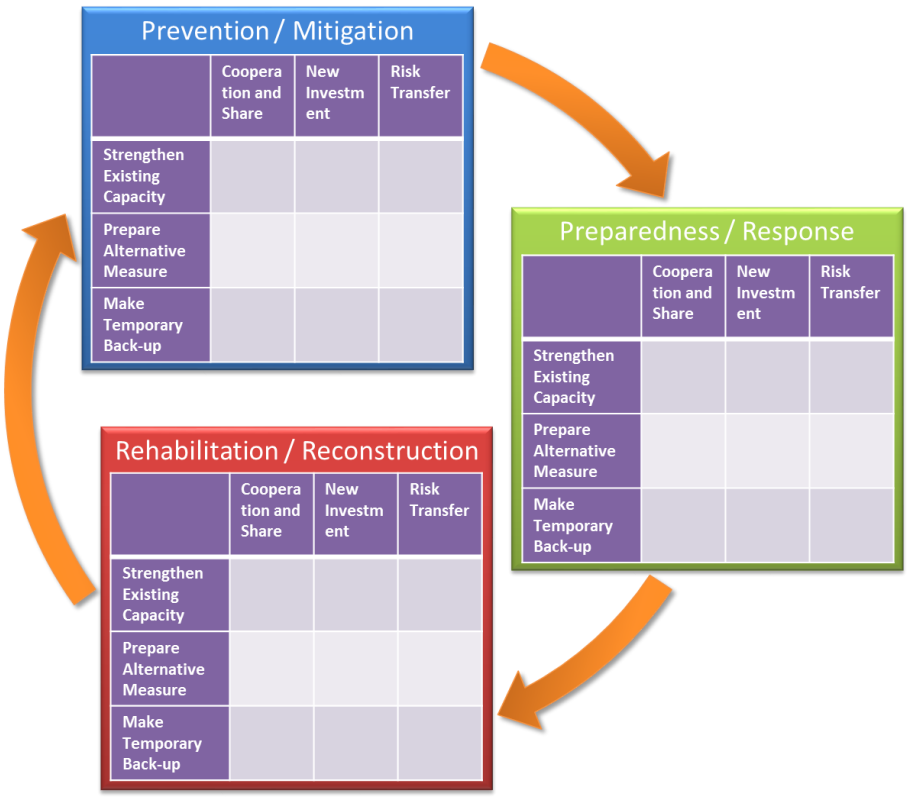


Figure 9 : Combined tactics and Multi Schemes on balanced Disaster Management Cycle

The entity that takes the initiative towards developing an Area BCM and leads the discussion differs according to country and local conditions. In the three areas, the prefecture level of government in Indonesia, the municipality (Peoples Commission) in Vietnam, and an authority overseeing the economic sector (Philippines Economic Zone Authority) in the Philippines took the lead intensely. And some of those are now considering to make legal framework under their administration for the Area BCM system in the pilot area.

4 Benefit of Area BCM

The Area BCM process unifies the efforts of stakeholders of the area, directs them toward a common goal, and allows the area to achieve recovery and reconstruction quickly, efficiently and effectively. Through the range of measures, for example, the method selected, can help to encourage each business continuity manager to consider how to secure available business resources. They also develop ways of cooperating through enhanced communication with other partners by sharing information among related parties in the area, as well as the clients of each enterprise. Furthermore, these considerations can promote expanded coordination with other industrial agglomerated areas and other strategically critical areas. Coordination through the supply chain is also enhanced by preparing an alternative supply chain network.

Each organization's efforts were enhanced due to the increase in responsibility following the development and coordination of the Area BCM. Even companies that currently have no BCP/BCM may still start developing their own BCP/BCMs. Moreover, cross-industry cooperation resulting from Area BCP/BCMs can further promote cooperation among line industries. It automatically distributes the concept of the Area BCMs to other areas. Another benefit of Area BCP/BCMs is that they can give private companies the incentive to prepare plans for each stage of the disaster management cycle (prevention and mitigation, preparedness and response, restoration and rehabilitation), rather than following the usual tendency to prepare only the plans for a response due to their financial constraints and lack of experience. Private parties will be involved more deeply in planning structural measures of risk reduction on an area-wide scale for example. In disaster risk reduction, it is understood that some extent of redundancy in measures and functions is important in order for taking backup measures and alternative actions effectively. The combination of different schemes under the Area BCM, consisting of sharing resources, investing in measures to minimize the effects of disasters while transferring risks, will add more redundancy to the area's resilience. The public sector is also encouraged to invest in developing more robust infrastructure. Since the regeneration of local jobs, the reconstruction of people's living environments 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 increase their capacities in the area surrounding disasters. Linking individual efforts of companies and public organizations, opportunities under the Area BCM can enhance strategic operations in normal businesses to avoid unexpected business risks and eventually contribute to disaster prevention as well as sustainable growth for all concerned parties.

Although it is premature to evaluate the total benefit of the Area BCM, the enhancement of resiliency may encourage other enterprises to transfer their operations to the target area, where disaster risks are rather low compared to the other areas. The increased resilience of the area would also be reflected in the asset value as for investment environment, which could pull down the disaster insurance costs of local enterprises. If the cost reduction follows, it will attract more investment to the industry area. Enhanced continuity of the business in the area as a result could foster the local economy and employment, which may have huge impact to the nation. Enhanced continuity of business in the area could result in fostering vital economy, which may then bring substantial benefits to the nation. The process of Area BCP/BCM promotes all the engaged parties to be aware of the connections (Figure

10) to other members and helps the private sector to prepare well-balanced and standardized plans for all the stages in the disaster management cycle.

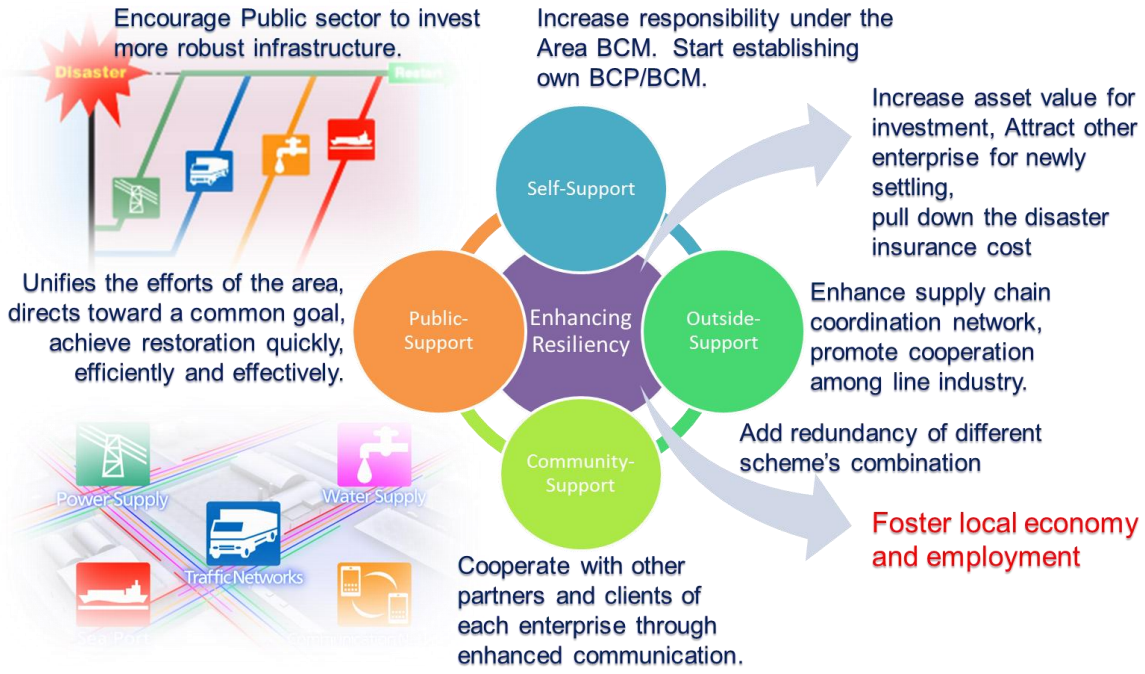


Figure 10 : Connectivity of stakeholders and benefit of Area BCM

5 Private Sector's Role

Economic losses as a result of disasters – particularly of catastrophic disasters in industry agglomerated areas – have extensive economic impacts for nations and to the global economy. As noted earlier, loss of employment and population outflow from the area can also have irreversible social impacts. The private sector can play a significant role in promoting resilient continuation of area business and early regeneration of local industry. In addition, the public sector also needs to pay attention to industrial agglomeration areas in order to avoid catastrophic impacts on the national economy by developing strategies for area-wide disaster management and involving the private sector in the system of the management.

To encourage contributions by both private and public sectors, the preparation of area-wide coordinated systems of disaster risk reduction such as Area BCP/BCM, as introduced in this chapter, is becoming an increasingly important means of enhancing area resiliency to disasters or other threats of business disruption. The Area BCM enables all the stakeholders of private and public sectors to create mutual links and connectivity to avoid unexpected risks of losing assets and benefits. Two important questions here concern who will first take the leading initiative of the Area BCM in the area of industry agglomeration. And who will need to do what?

As the case study revealed, the entity that takes the initiative in developing the Area BCM and leads the discussion of strategies and actions may differ according to country and local conditions. In some cases, local government will be the leader. In recent years, authorities in the industrial and economic fields have become more interested in taking on initiatives and developing the concepts of area-wide resilience to disasters. While the private sector is definitely a part of the area-wide framework, it is not usually at the center of the management system. However, it is not an easy task for private enterprises to implement the scientific risk and impact analysis, which is based on an area-wide, multi-hazard, multi-scenario and probabilistic methodology, as mentioned. As this comprises one of the essential steps of the Area BCM, some public organizations should take the central role of implementing the Area BCM.

However, the role of private sector remains important. First, participation of all key stakeholders in the Area BCM System is essential to ensuring effective coordination. Private-public cooperation will provide the basis for generating the Area BCM process. Moreover, the private sector, as an actor in implementing disaster management plans in the actual location, should be able to provide coordination between the entities in the areas concerned and those in the external regions through inter-regional networks, industrial chains and supply chain cooperation.

Second, it needs to recognize that general management in private organizations may not take the process as seriously as they should, asking BCP managers to write something, or saying anything to make the auditors go away (Wallace, 2010). Conversely, after participating in an Area BCM process, private enterprises then have the responsibility of linking their own BCPs to the Area BCP. For example, to share the risk information, all parties would need to disclose information related to business resources, current capacities and any hazardous materials. This will effectively be reflected in the Area BCP formulation. The

individual BCP will then interactively be reviewed by each private enterprise with serious concern. Constant dialogue and simulation exercises can also be effective in revealing the risks and difficulties that each stakeholder faces. It enables them to prepare a well-balanced and coordinated initial response capacity for catastrophic disasters with effective and efficient use of existing resources.

Learning from recent large-scale disasters that disrupted external resources, which were essential for each enterprise's business continuity, the private sector as a group of enterprises should also encourage the public sector to strengthen the external resource's resilience to disaster through a framework of area-wide cooperation. Since the industrial function of any specified area depends on critical common resources and infrastructure, including the ones outside the area, the concerned private enterprises should create a capacity as a coordination framework with the public sector including local and national governments to secure the local economy.

The first application of such framework, the Area BCP/BCM in industrial agglomerated areas, has been introduced in ASEAN. Since the concept of Area BCP/BCMs is still new, the experienced members of the private sector are expected to disseminate the lessons and knowledge of Area BCP/BCMs in other industry agglomerating areas and nations. Also, this concept of area-wide resiliency will be applicable not only to industry agglomeration but also for urbanization. To foster sustainable urban development, together with vital economic growth of each locality, private and public cooperation needs to be strengthened through the new opportunities presented by coordinated risk management.

The recent efforts of the private sector indicate what can be achieved and what challenges remain. The private sector can promote disaster resilience by developing BCPs and establishing BCM systems, as well as strengthening supply chain networks to ensure backup of business operations. The concept of shared resource management is also becoming better understood. In some companies, the BCM plans have included concepts of corporate social responsibility (CSR) in emergency events, by incorporating plans for helping affected people. However there is still more progress to be made. Area-wide disaster management with significant participation of stakeholders is one area where further progress is necessary in order to scale up the coordination system of resilient society. In this, the private sector can provide one key to success.

6 Where is the Area BCM going?

The Area BCM is a part of JICA's cooperation strategy for mainstreaming DRR into all development interventions. The private sector's participation in DRR initiative is one of the newly arising agenda we have discussed after the adoption of HFA, reflecting the intensifying disasters, increasing catastrophes and consequent economic loss in local to global as mentioned.

JICA, through the Area BCM together with other newly developed resources such as the macroeconomic model to prospect how DRR will be effective, contributes for the discussion of HFA2 (the successor framework to the HFA) by providing the structured cooperation strategy with four pillars and a base (Figure 11).

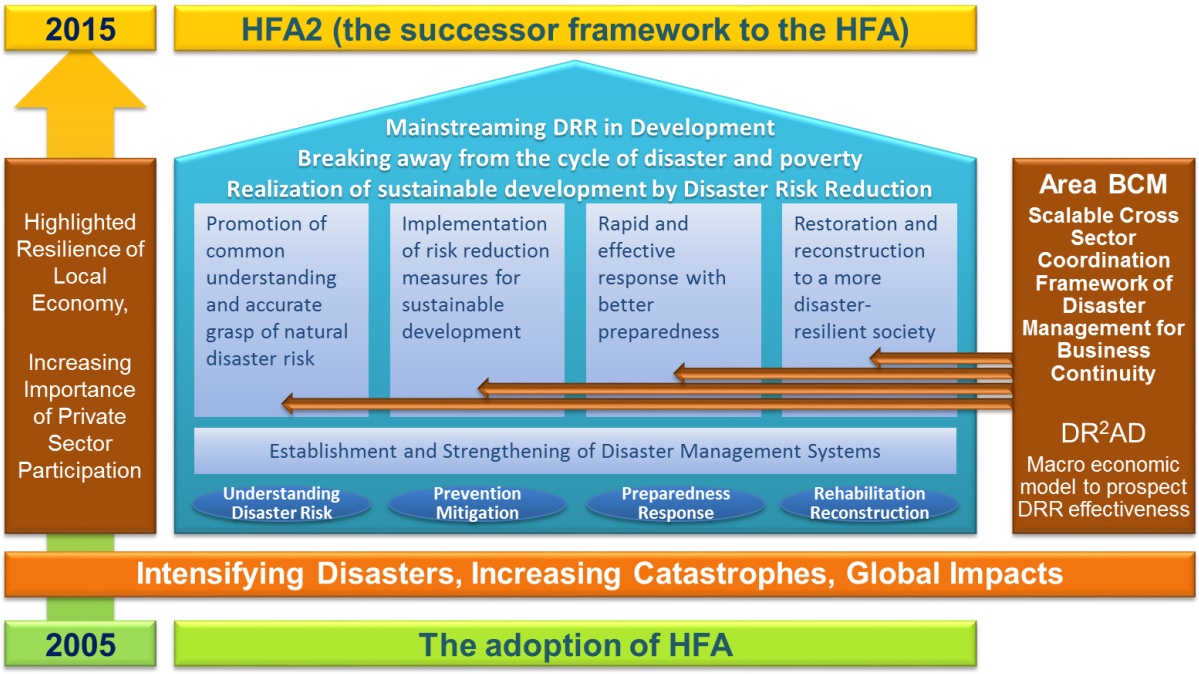


Figure 11 : Area BCM contributes in HFA2 through realization of sustainable development and resilient local economy.

References

Ando, M., and F. Kimura, 2012: How did the Japanese Exports Respond to Two Crises in the International Production Networks? The Global Financial Crisis and the Great East Japan Earthquake. *Asian Economic Journal*, 26 (3), 261-287.

Baba, H., I. Adachi, H. Takabayashi, N. Nagatomo, S. Nakasone, H. Matsumoto, and T. Shimano, 2013: Introductory study on Disaster Risk Assessment and Area Business Continuity Planning in industry agglomerated areas in the ASEAN. *Journal of Integrated Disaster Management (IDRiM Journal)*, Vol.3 No.2, Dec. 2013, 184-195.

Building Seismic Safety Council, 2009: NEHRP Recommended Seismic Provisions for New Buildings and Other Structures, Federal Emergency Management Agency, USA

Dilley, Maxx, Robert S. Chen, Uwe Deichmann, Arthur L. Lerner-Lam, Margaret Arnold with Jonathan Agwe, Piet Buys, Oddvar Kjekstad, Bradfield Lyon, and Gregory Yetman, 2005: Natural Disaster Hotspots: A Global Risk Analysis. The World Bank Hazard Management Unit. <http://www-wds.worldbank.org/external/default/WDSContentServer/IW3P/IB/2005/11/23/000160016_20051123111032/Rendered/PDF/344230PAPER0Na101official0use0only1.pdf>

GPDRR, 2013: Chair's Summary. Fourth Session of the Global Platform for Disaster Risk Reduction, Geneva, May 21-23, 2013.

Imamura, Fumihiko., Ahmet Cevdet Yalciner and Gulizar Ozyurt, 2006: Tsunami Modelling Manual, Revision due on APRIL 2006, <http://www.tsunami.civil.tohoku.ac.jp/hokusai3/J/projects/manual-ver-3.1.pdf>

ISO, 2012: Societal security -- Business continuity management systems --- Requirements. ISO 22301:2012. International Organization for Standardization (ISO). <http://www.iso.org/iso/catalogue_detail?csnumber=50038>

Japan Machinery Center for Trade and Investment (JMC), 2000: Proposal about the Japanese company for contributing to symbiotic development of the electricity and the electron / IT industry in Asia, and the role of the Japanese government. [in Japanese] <http://www.jmcti.org/kaigai/doc/kaigai082000ap.pdf>

Jha, Abhas K., and Zuzana Stanton-Geddes (Eds)., 2013: Strong, Safe, and Resilient: A Strategic Policy Guide for Disaster Risk Management in East Asia and the Pacific. The World Bank. <https://www.gfdrr.org/strongsaferesilient>

J.P. Morgan, 2011: Global Data Watch. *Economic Research*, November 11th, 2011. <http://www.adr.com/Home/LoadPDF?CMSID=2c3de19feb2943fd982284c56c16b176>

Kagiya, Hajime, and Chikako Isouchi, 2009: Research of regional contribution and cooperation in Business Continuity Plan. *Proceedings of the annual conference of the Institute of Social Safety Science*, No. 25, November 2009.

Komori, D., S. Nakamura, M. Kiguchi, A. Nishijima, D. Yamazaki, S. Suzuki, and T. Oki, 2012: Characteristics of the 2011 Chao Phraya River flood in Central Thailand. *Hydrological Research Letters*, 6(0), 41-46.

Mellor, George L., 2004: Users Guide for a Three-dimensional, Primitive Equation, Numerical Ocean Model, Program in Atmospheric and Ocean Sciences, Princeton University, Princeton.

METI, 2010: White Paper on International Economy and Trade 2010. Ministry of Economy, Trade and Industry, Japan.
<http://www.meti.go.jp/english/report/data/gIT2010maine.html>

METI, 2012: *White Paper on International Economy and Trade 2012*. Ministry of Economy, Trade and Industry, Japan.
< http://www.meti.go.jp/english/report/data/gIT2012maine.html>

Ministry of Economy, Trade and Industry (METI), 2012: Guidelines on Formulating and Implementing BCPs for Small and Medium Enterprises. Ministry of Economy, Trade and Industry (METI) Japan. <http://www.meti.go.jp/english/press/2012/0427_05.html>

Myers, V.A., 1954: Characteristics of U.S. hurricanes pertinent to levee design for Lake Okeechobee, Florida, *Hydro-meteorol. Rep*. No. 32, Weather Bureau, U.S. Dept. Commerce, 106p, 1954.

Nguyen Hong Phuong, Vu Ha Phuong and Pham The Truyen, 2013: Simulation of a Worst Case Tsunami Scenario from the Manila Trench to Vietnam, The Joint Symposium of Seismic Hazard Assessment - Sendai, Japan, 17-19 June, 2013.

Okada, Norio., 2011: *Integrated Disaster Management in Japan and Lessons from the March 11 events*, High-Level Roundtable on the Financial Management of Earthquakes, Paris, 23-24 June, 2011, OECD Headquarters. <http://www.oecd.org/dataoecd/1/24/48440903.pdf>

Okal, Emile A., Costas E. Synolakis and Nikos Kalligeris, 2011: Tsunami Simulations for Regional Sources in the South China and Adjoining Seas, Pure and Applied Geo-physics, Vol. 168, pp. 1153–1173

Okamoto, A., H. Hayashi, K. Tamura, M. Inouchi, H. Someya, Y. Nanbu, 2011: Development of Business Continuity Plan for Efficient Expressway Operation for Various Risks : A Case Study on West Nippon Expressway Co, Ltd. [in Japanese] *Journal Article*, Institute of Social Safety Science, (15), 323-332.

Ota, Saburo, 2011: An Empirical Study of Bankruptcy and Turnaround in Post-March 11 Northeastern Japan : Corporate Risk Management for Natural Disasters. *Management Journal*, 4: 23-44.

Saito, Yukiko Umeno, 2012: Impact of East Japan Earthquake Disaster on Companies in Non-affected Area - The Structure of Inter-company Network of Supply Chain and lts Implication - . *Japan Statistical Society*, 42 (1): 135-144.

Sato, Koji, and Yusuke Bessho, 2011: Regional Disaster Measures and Business Continuity Plan for Logistics. *Proceedings of the annual conference of the Institute of Social Safety Science*, No. 28, May, 2011.

Special study team for earthquake and tsunami countermeasures learning from the Great East Japan Earthquake, 2011: *Interview survey results of evacuation actions in the Great East Japan Earthquake*, Central Disaster Management Council. 7th meeting on the Great East Japan Earthquake, 16 August 2011, distribution papers No.1 <http://www.bousai.go.jp/jishin/chubou/higashinihon/7/1.pdf>

Waugh, W. L. Jr., 2009: *Mechanisms for collaboration in emergency management: ICS, NIMS, and the problem with command and control.* The collaborative public manager: new ideas for the twenty-first century, 157-175.