

MARITIME GCI SUMMARY WORKSHOP REPORT

**International Workshop on Risk Governance  
of the Maritime Global Critical Infrastructure:  
Straits of Malacca and Singapore  
Exposed to Extreme Hazards**

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## EXECUTIVE SUMMARY

A two-day multi-stakeholder workshop on the "Risk Governance of the Maritime Global Critical Infrastructure: Straits of Malacca and Singapore Exposed to Extreme Hazards" took place on June 4 and 5, 2009, in Kyoto, Japan. The objectives of this event were, firstly, to provide information and perspectives on the development of guidelines for the risk governance of the maritime global critical infrastructure and, secondly, to provide an opportunity for participants to identify further necessary research or other follow-up activities in this very important field.

This report summarises the presentations and discussions from the workshop. The participants discussed crucial governance issues related to the Straits of Malacca and Singapore as well as traditional and emerging hazards and risks to major Asian ports and their hinterland infrastructure. Presentation topics included: lessons learned from disaster events in Asia; threats of extreme natural and man-made hazards; and, interdependencies among major ports and between a port and its hinterland infrastructure.

Since the late 1960s, the Malacca Strait Council has put tremendous efforts into addressing and resolving risk governance issues in the Straits, focussing primarily on navigational safety and preservation of the marine environment. Other issue-specific agreements and initiatives have also been undertaken to deal with e.g., haze pollution, maritime security, robbery and piracy. However, issues that have not yet been addressed in international agreements are:

- Disaster prevention and reduction of extreme hazards and risks in the Straits of Malacca and surrounding ports;
- Interdependency issues among major Asian ports; and
- Contingency plans for disaster recovery after catastrophic events affecting coastal Asian megacities.

The workshop was a first step towards bringing stakeholders together to discuss policy implications of the above-mentioned issues, using IRGC's risk governance framework to help structure the discussion. It should be noted that most of the participants were not necessarily familiar with the methodologies of risk management. Therefore the IRGC Risk Governance Framework was proposed as a methodology to structure the process; however, there may be a need to reconvene in order to develop a common understanding of the framework and adapt it to an Asian context before it can be adopted.

The workshop was supported by the International Risk Governance Council (IRGC), the Disaster Risk Prevention Institute (DPRI) as well as the Global Centre of Excellence (GCOE) at Kyoto University, the Centre for Maritime Studies at the National University of Singapore, the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) of Japan and the Central Research Institute of Electric Power Industry (CRIEPI).

The opinions contained in this report were expressed by the participants and should not be understood as factual, scientific evidence.

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# 1 INTRODUCTION

Recent decades have witnessed a tighter integration of economies: the world has become a global marketplace strongly dependent on infrastructures which have developed into globally networked systems. Their malfunction or disruptions to service may cause extensive, transboundary effects and spread to other systems. The global maritime shipping and trade networks, driven by “just-in-time” logistics policies, clearly qualify as a global critical infrastructure. Within their critical path are a very limited number of corridors (straits) and entry/end points (super-hubs capable of handling the biggest ships); these are highly critical elements. The Straits of Malacca and the Port of Singapore, both of which are vital for trade between Asia and Europe and the Middle East, serve as eminent examples of a critical maritime corridor and global hub-port.

Risk governance is defined as "the identification, assessment, management and communication of risks in a broad context. It includes the totality of actors, rules, conventions, processes and mechanisms concerned with how relevant risk information is collected, analysed and communicated, and how and by whom management decisions are taken and implemented." [IRGC, 2009] What appears to be missing in the risk governance structures and processes in the Straits<sup>1</sup> is the extension of the focus on navigation safety and environmental protection to the identification, consideration, assessment, management and communication of natural and man-made extreme events and foreseeable developments, including the effects of climate change and cyber attacks, and their potential impacts on regional and hinterland infrastructure and other infrastructures related to global shipping.

The purpose of the international workshop on the risk governance of the maritime global critical infrastructure was to initiate a dialogue among various stakeholders with the desire to create a platform for effective communication and networking. This was intended as a first step in addressing crucial governance issues in the Straits and in interlinked major Asian ports. The workshop also provided an opportunity to share knowledge on lessons learned from disaster events in Asia, on threats of extreme natural and man-made hazards that may cause a major Asian port to shutdown, and on interdependencies among major ports in a network as well as between a port and its hinterland infrastructure.

## 1.1 OUTLINE OF SUMMARY REPORT

This report is a summary of the information and insights shared during the workshop. The content is organised into three parts: language; knowledge; and strategic timing. Figure 1 illustrates the structure of the report.

*Section 1* provides a brief introduction to the workshop. It includes a rough evaluation of the representation of stakeholders and of the actual outcomes of the workshop compared to the original objectives and expected outcomes. A summary of the major lessons learned during the workshop sets the stage for the rest of the report.

*Sections 2 and 3* go into depth on the development a common language. Section 2 consists of the definition of terms and Section 3 records the points put forth as important for the risk governance of the maritime global critical infrastructure. Both sections are integral to work intended to bring stakeholders with different interests to see a common vision.

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<sup>1</sup> The term, "the Straits", refers to the Straits of Malacca and Singapore. (Note that lower-cased "straits" refers to any narrow channel of the sea joining two larger bodies of water.)

Sections 4 and 5 summarise the information shared in the presentations during the workshop and the knowledge characterisation (intelligence level) of risks encountered in the maritime global critical infrastructure. Section 4 provides the different perspectives on extreme natural hazards, man-made security threats and the interconnections between them, whereas Section 5 deals with the knowledge gaps in the projection of consequences.

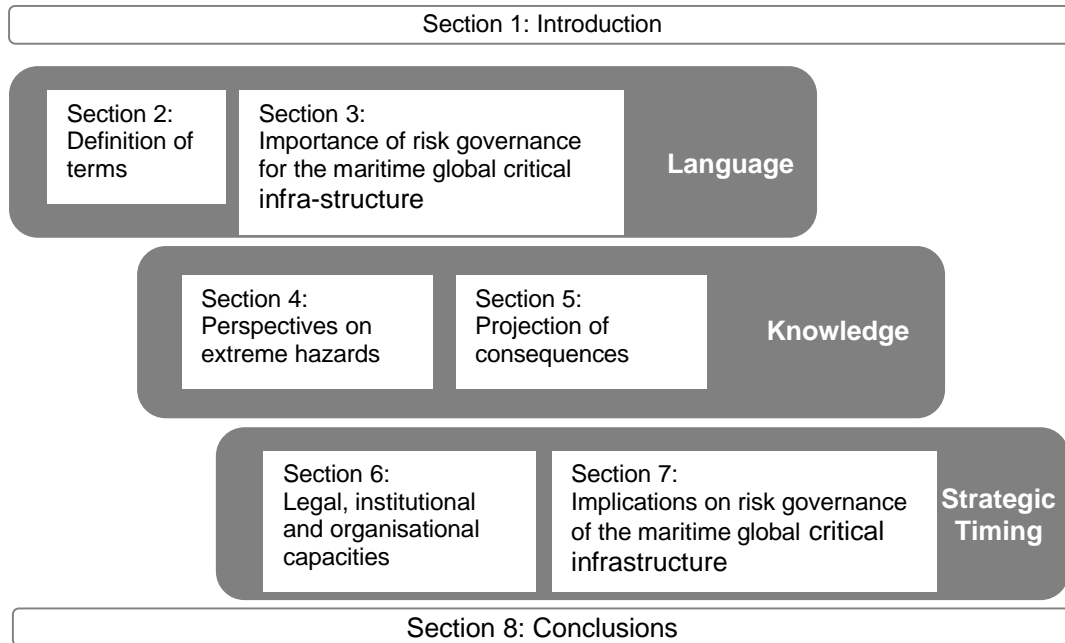


Figure 1: Structure of workshop summary report.

Sections 6 and 7 relate to the issues of timing strategic initiatives, decisions and policies. More specifically, Section 6 makes explicit the legal, institutional, and organisational capacities and the sensitive issues of governing the Straits. Section 7 then explores the implications of all of the issues raised in preceding chapters for the risk governance of the maritime global critical infrastructure. Specific challenges to the risk governance process and possible recommendations on how to overcome them have been extrapolated from the workshop discussions.

Finally, Section 8 concludes the report by highlighting the main take-away points and offers a proposal for future steps.

## 1.2 STAKEHOLDER REPRESENTATION

The principle of the multi-stakeholder workshop on risk governance of the maritime global critical infrastructure was to engage persons with a stake, an interest, or influence in the topic in a multidisciplinary, cross-sector, transnational dialogue.

The diversity of the participants who attended and contributed to the workshop is summarised in Table 1.

Table 1: Diversity of workshop participants.

a) Representation by country		b) Representation by sector		
Japan	20	Research	Academic Research	26
Singapore	6		Industry Research	3
Malaysia	1		Policy Research	3
Indonesia	0	Regulator	Government	2
Korea	3		Port Authority	1
China	2	Industry	Insurance	1
India	2		Airport	1
Outside Asia	4		Shipping	0
<b>Total</b>	<b>38</b>	NGO	NPO	1
			Foundations	0

Even though the majority of participants were from Japan, almost half of the participants came from other countries. Most participants were from academia, but around 30 percent of participants were from other sectors, such as the insurance industry, a port authority and government.

### 1.3 MAJOR OUTCOMES FROM THE WORKSHOP

A week prior to the workshop, a background briefing report [KU and IRGC, 2009] was distributed to participants. This document included the objectives and expected outcomes of the workshop, questions to consider during the discussions, and a summary of what is known and what more needs to be done with regard to risk governance of the maritime global critical infrastructure. The objectives of the workshop were:

- To address vulnerabilities of major straits and interdependent global hubs closely linked to international maritime transport networks, all susceptible to extreme natural hazards;
- To bring these vulnerabilities into perspective with other malevolent events, malicious attacks and the interactions among them;
- To examine possible consequences of those events causing paralysis of national/regional/global transport infrastructures and harm to the local/regional/global economy;
- To assess the state of knowledge and analytical instruments;
- To assess recovery concepts/strategies and the role of hinterland support infrastructure;
- To reflect on existing legal/organisational frameworks and integrated governance concepts and to identify risk governance issues and opportunities where appropriate; and,
- To develop risk governance recommendations for policymakers and decision support needs.

From the briefing report, the expected outcomes of the workshop were:

- An inclusive conversation among stakeholders to identify common interests, while also respecting the diversity of valid perspectives and interests;
- A plan to formulate policy recommendations and actions to guide international negotiations and agreements, which are adequate at addressing risk governance issues and acceptable to all stakeholders;
- A prioritised list of new research initiatives and multiple low-impact application experiments on early warning systems, financial risk management mechanisms, social networking, training and integration of emergency preparedness in day-to-day operations, mock risk scenarios and so on;
- A collection of scenarios where wide-area consequences result from cascading interconnected disasters, triggered by an extreme hazard event;
- A list of risk governance issues relevant to the maritime global critical infrastructure and suggestions for how these may be resolved;
- An inventory of success models, principles, paradigms and practices that can be upgraded or expanded to include the disaster risk prevention dimension, so that disasters may be reduced (mitigated or prepared for); and
- Potentially, an agreement to reconvene in a year to share new knowledge, report on progress and to re-assess the risk governance issues of the maritime global critical infrastructure as well as, if appropriate, to assess whether or not the procedure and recommendations may be applied to other global critical infrastructures.

At the very outset of the workshop, concern was raised among the participants that the expected outcomes would be too ambitious to realistically achieve in just two days. The agenda for the workshop is appended to this report (see Appendix B). It was agreed that in order to achieve its objectives, the workshop should be the starting point of a longer-term network of stakeholders, including policymakers, regulators, academic and industrial researchers and key players from public, private and civil sectors concerned with and by the maritime global critical infrastructure.

Using the perspective of global critical infrastructures allowed consideration of a new way of thinking to develop knowledge and understanding among stakeholders to address transboundary, cross-sector and multilateral issues. In fact, the workshop can be said to be a resounding success for the sole reason that participants have committed to continue the dialogue and to take actions to consolidate and extend the network. The commitments from participants in the workshop stems from the major lessons learned during the workshop.

#### 1.4 MAJOR LESSONS LEARNED FROM THE WORKSHOP

The lessons learned that participants shared during the workshop effectively led to the conclusion there is a need to improve the risk governance of the maritime global critical infrastructure, particularly in the Straits and in an interlinked network of major Asian hub-ports. These lessons can (as suggested by one workshop participant) be grouped into three categories: (1) language, (2) knowledge and (3) strategic timing. A common language is needed for the development of knowledge, which, in turn, is necessary for the strategic timing of decisions and actions. The cascading interaction among these components is illustrated in Figure 2.

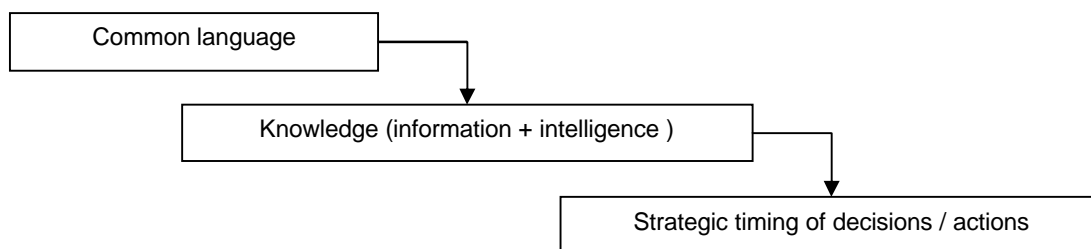


Figure 2: Cascading development process of good risk governance

A *common language* is necessary for effective communication. In general, participants found that the capacity for risk communication was lacking. Specifically, communicating risks of extreme hazards and interrelated cascading events to policymakers and corporate decision-makers requires both a suitable tone and the appropriate medium to convey the correct message. The tendency is for short-term economic costs and benefits, as well as investment risks to increase one's own competitiveness, to dominate the dialogue. Communicating other risks, including long-term collective financial risk, is difficult because the factors or conditions leading to risk (e.g., values and beliefs, vulnerability, inequity and interdependencies) are not easily perceived, defined or measured without discourse. It is recognised that all stakeholders share a common interest to protect global critical infrastructures, but methods, models, and processes need a common communicative basis to bring the interested parties together. This problem in communication may be overcome with greater networking and outreach.

Only after a common language has been developed can *knowledge* be generated. Knowledge gaps exist: significantly, there is currently no clear evidence of the risks and vulnerabilities of the maritime global critical infrastructure nor is there any validated metric to determine which ones are most important. Workshop participants agreed that the Straits and global hub-ports are part of the maritime global critical infrastructure. Risk assessment was deemed important to the governance of the Straits and the interconnected network of hub-ports. However, the components necessary for conducting a proper risk assessment are lacking, i.e., there is no conceptual framework for identifying knowledge gaps nor are there the tools to fill in these gaps.

Past natural disasters (such as the Isewan Typhoon, the Hanshin Awaji earthquake, Typhoon Maemi and the Wenchuan earthquake) affected major ports and led to greater focus on disaster prevention and recovery in the affected areas. The 9/11 terrorist attacks, subsequent attacks in London, Madrid and Mumbai, and the recurring terrorism threats have triggered increased attention on the security of potential terrorist targets, including global hub-ports and maritime corridors. Foreseeable developments such as climate change, urbanisation and the prolific use of information and communication technology (ICT) in managing and controlling logistics, navigation systems and security systems, add to the list of natural, man-made hazards and technological risks. Typically, these hazards and threats are currently being dealt with in isolation (single threat) and separately (each government, independently). The capacity to deal with cross-boundary risks (e.g., a collision causing contaminant spills and long-term environmental and human health risks in the Straits) is only just starting to be developed. Furthermore, systemic (cross-sector cascading) risks (e.g., a bunker explosion leading to port shutdown causing a delay in just-in-time shipments, resulting in loss of competitiveness for industries and shortages in energy supply for the electric power industry) are of potentially great

significance. The workshop recognised that developing knowledge to assess extreme, correlated and cascading risks in the maritime global critical infrastructure and to establish metrics is another priority.

Finally, the *timing of decisions and actions* is crucial for effective risk governance. Dynamic processes, such as climate change and the rapid modernisation of technologies and facilities are taking place. These require strategic and adaptive risk governance.

Comprehensive risk management seeks to prevent disasters where possible, mitigate the impacts of a disaster as much as possible, and respond and recover from disasters as quickly as possible. It is pertinent that the UN Convention on the Law of the Sea, Article 43, declares that user States and States bordering a strait should, by agreement, cooperate in the establishment and maintenance of navigational and safety aids and for the prevention, reduction and control of pollution from ships [UN, 1982]. The growth of international trade, economic development and sophistication of technology has not been accompanied by a commensurate rate of change in laws and policies. As a result of globalisation, the private sector and civil society have become important players with roles and responsibilities in partnership with government for the risk governance of the maritime global critical infrastructure. Thus, cooperation among the different players is essential and should be strategically coordinated to leverage their specific capabilities. In order to do this, professional assistance is required to support the sharing of information in a manner that does not compromise the sovereignty of government, competitiveness of industry or the rights of civil society. The workshop participants themselves, who mainly comprised an agglomerated research group, can play a key role in gathering and providing this information.

## 2 DEFINITION OF TERMS

During the workshop, the definition of some key terms and new concepts were discussed. In some cases, the distinctions were clear, whereas in other cases no conclusive definitions were agreed upon.

### 2.1 RISK VS VULNERABILITY

Kaplan and Garrick [1981] define risk to be a set of scenarios, each of which has a probability and a consequence. Generally, the probability attached to each scenario characterises the exposure to a hazard, and the consequences are losses that would be incurred due to the hazard. Hence, risk management has sometimes been focused on controlling the hazard or minimising the probability of its occurrence. However, risk management also has to take the aspect of consequences into account. In order to enhance the vocabulary of risk managers, *vulnerability* has been introduced as another dimension of risk which needs to be considered. Vulnerability refers to the extent to which a target can experience negative consequences resulting from exposure to a hazard. The higher the vulnerability, the higher the consequences will be. The focus of management then shifts to reducing the vulnerability and increasing the resilience to an uncontrollable hazard. Vulnerability can be characterised e.g. in terms of the size of a population (loss of lives), the concentration of valued assets (property damage), or the size and complexity of infrastructure (capital losses). The workshop concluded that, to be comprehensive in risk governance, both risks (exposure to hazards) and vulnerabilities should be explicitly addressed.

### 2.2 NATIONAL CRITICAL INFRASTRUCTURE VERSUS GLOBAL CRITICAL INFRASTRUCTURE

Critical infrastructures may be defined as networks of independent, large-scale, man-made systems composed of hard and soft structures that function collaboratively and synergistically to produce a continuous flow of essential goods and services, and are deemed essential for economic development and social well-being [PCCIP, 1997; IRGC, 2006, p. 15]. During the workshop, a participant raised the question of the distinction between national critical infrastructure and global critical infrastructure.

As early as the time of the Han Dynasty (206 BC–220 AD), transportation by sea and the establishment of ports have played an important role in opening up trade routes and fostering international relations [Curtain, 1984]. However, it can be argued that globalisation has placed maritime shipping and its infrastructure in a critical role for economic development and the social well-being of societies world-wide. Specifically with regard to the Straits, Japan's electric power industry depends on the clear passage of the Straits to receive energy sources to generate electricity. More than 70 percent of Japan's oil imports pass through the Straits [Ahmad, 1997]. If the Straits were to be blocked, Japan's electricity supply would be significantly affected. In 2008, China imported 48 percent (179 million tons) of its crude oil consumption [China Daily, 2009], of which 50 percent originated from the Middle East and 30 percent from Africa, most of which would presumably pass through the Straits [ETC, 2009]. Two of the world's largest economies are thus dependent on the Straits for the flow of goods to and from the Middle East, Europe and Africa. A disruption in the Straits could have a devastating impact on trade flows, threatening economies, energy security and other critical infrastructures. It was intuitively argued that the Straits are a critical

point within a global critical infrastructure. However, due to the infancy of research, there is still a lack of agreed upon metrics to determine whether this is the case.

Additionally, while major ports are important to local and regional economies, it is likely that only a few ports can claim the title of global hub-port. The Port of Singapore is arguably a critical point within the maritime global critical infrastructure due to the amount of shipments it handles, its capacity in terms of the number and size of vessels that can be docked, and the number of connections to other ports worldwide. Other emerging mega-ports such as Shanghai and Busan are also rising to global status [Asahi Shimbun, 2009]. These and other mega-ports may be seen as being more “critical” to the maritime global infrastructure than others. In order to prioritise unacceptable risks and allocate resources to address them there is, the workshop agreed, a need to define the landscape of “criticality” in the maritime logistics network. Selecting appropriate criteria and metrics will also require an international discourse.

### 2.3 PIRACY AND ROBBERY VERSUS TERRORISM

Vessels with valuable cargo or personnel run the risk of being boarded and robbed. A participant made the distinction that in international waters this is called piracy, but since the Straits are viewed by the Littoral States<sup>2</sup> as territorial waters rather than international waters, it is sometimes referred to as robbery. Whichever term is used, the Straits are not exempt from this problem and the three Littoral States are working together to patrol the waters. A recorded decrease of incidents is a testament to their efforts [IMB, 2008].

Terrorism is a concern to the international community as well as to local authorities where attacks have occurred. While the Straits is a potential terrorist target, terrorism and piracy should be understood as distinct events with very different causes, although with similar consequences. Pirates steal to live, while terrorists destroy to create shock and fear to gain control. Robbery is a social problem, while terrorism is political. Combatting these threats requires very different strategies and tactics to detect them and intervene appropriately.

### 2.4 INDIVIDUAL AND COLLECTIVE COMPETITIVENESS RISK

Finally, in placing the issues into the perspective of the “maritime global critical infrastructure under composite risks of some extreme event,” a new idea was suggested: to reexamine the idea of “competitiveness risk” by referring to the relationship between individual competitiveness risk and collective competitiveness risk. According to one participant, collective competitiveness risk would be of particular interest to Singapore, because Singapore's national economy depends largely on its competitiveness internationally, particularly the competitiveness of the port of Singapore. However, limited attention has so far been given to potentially serious risks involved in a broader logistical and transport system. This includes risks of unidentified extreme events in the the Straits (a maritime corridor).

The workshop considered that a definition of competitiveness risk should be based primarily on existing literature on competitive market theory in economics. For this purpose some criteria need to be used to define both competitiveness as well as the time-scale under consideration (short-term, medium-term, long-term). Therefore, competitiveness risk (if measured by financial impact) should take into account costs under *uncertainty* and over varying *time-scales*. For example, the cost of both direct

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<sup>2</sup> The Littoral States of the Straits are Indonesia, Malaysia and Singapore.

costs and externalities should be included, as in the example of environmental and social health costs of pollution from a collision resulting in a contaminant spill. Competitiveness risk, particularly the collective variety, would take into account the likelihood of such an event's occurrence and the potential costs, including costs for clean-up, re-routing and loss of business. Another aspect of competitiveness risk is the time horizon. With only short-term risk perception, the competitiveness risk would be a measure of short-term competitiveness. When one wants to ascertain the long-term sustainability of a business, competitiveness risks on the medium to long-term horizon should also be measured. To do this, what is needed is a vision of where one wants to be in the future. This process would be helped by inviting a broader range of stakeholder to the next workshop, such as economists and management specialists.

By envisioning the future, workshop participants imagined a transformation in business mentality that would broaden the focus from individual (e.g. country; company) competitiveness risk, towards collective (e.g. region; business sector) competitiveness risk. It would be collective in the sense that one's competitiveness would be more dependent on the actions of a group rather than by oneself. Advanced research in group decision-making and negotiation could help define and refine the concept of collective competitiveness risk in the context of the maritime global critical infrastructure.

The terms described above are examples taken from the workshop discussions. It was concluded that certain terms and concepts need to first be clarified or further defined so that the problem definition is unambiguous, in order to move on to risk governance.

### 3 IMPORTANCE OF RISK GOVERNANCE FOR THE MARITIME GLOBAL CRITICAL INFRASTRUCTURE

#### 3.1 FOR THE STRAITS OF MALACCA AND SINGAPORE

As the main seaway connecting the Indian Ocean with the South China Sea, the Straits is a crucial route for global seaborne trade. It is a gateway for oil, coal, iron ore and grain to the manufacturing centres of South- and North-East Asia. Conversely, it is an open door for the flow of high-value manufactured goods to consumer markets all over the world., Thirty percent of world trade worth USD 6.8 billion and 50 percent of world oil trade passes through the Straits [Khalid, 2006]. The passage thus represents an economic lifeline for the Littoral States as well as an energy lifeline for Japan and China.

Locally, the Straits is a unique, tropical estuarine environment rich in renewable and non-renewable natural resources. While the Straits are important to the global community, the local communities' interests must not be forgotten or ignored. Approximately 50 percent of locally-consumed fish comes from the Straits. The livelihoods of people living on the coasts would be directly and significantly impacted by any extreme hazards, natural or man-made. Blockage of the Straits may cause harm to the region and to surrounding hub-ports, which may never recover as detour routes could be made available and take away valuable business.

Due to the global economic importance of the Straits and the multiple interests of stakeholders, there is most certainly a need for multilateral risk governance to comprehensively assess, characterise, evaluate, and ultimately manage risks, vulnerabilities and concerns. Both for political and economic reasons, no single entity can manage safety and security in the Straits. With regard to the first,, the sovereignty of all Littoral States needs to be considered. Regarding the second, the costs of environmental protection, safety aids and security systems are much too high for one country to bear alone. There is therefore the need for regional and international agreements and cooperation to share the costs fairly in a manner that does not infringe on the independence of any State. Specifically, one participant stated that the costs of ensuring navigational safety and environmental protection are currently not borne fairly amongst Littoral States, user States and other beneficiaries of passage through the Straits. This opinion is echoed in a consensus document from the 2007 Symposium on the Enhancement of Safety of Navigation and the Environmental Protection of the Straits of Malacca and Singapore [Nippon Foundation, 2007]. While agreements attempt to apply the burden-sharing principle, the fruits of cooperation are yet to be sprung in the opinion of some [Valencia, 2006a].

The Straits are essentially a public good, which suffers from problems of free riding and the classic phenomenon of the "tragedy of the commons". Users of the Straits, including the shipping, transportation, energy (oil, gas and coal) and manufacturing industries, all benefit without having to contribute to the management of safety or security systems. Most of the countries in which these industries are based or whose flags are borne by vessels using the Straits contribute funds or support merely on a voluntarily basis, and when it is their own national interests. In order to be effective in the risk governance process, all stakeholders need to actively participate. It may require a concerted effort to persuade industries and governments from around the world to do so.

During the workshop, three different governance mechanisms (with varying levels of success) were discussed:

- First, on the issue of *robbery and piracy*, good outcomes were achieved with the Regional Cooperation Agreement on Combatting Piracy and Armed Robbery against Ships in Asia (ReCAAP), the first government-to-government agreement that addresses this threat in Asia.
- Secondly, on the issue of *haze*, which significantly reduces visibility in the Straits, there is the ASEAN Regional Haze Action Plan 1997 (not legally binding) as well as the ASEAN Fire Danger Rating System 1998, which was a Canadian-assisted project and acts as an early warning alert system. The Agreement on Transboundary Haze Pollution 2002 was introduced but has not yet been signed by Indonesia. Haze remains as a continuing risk problem.
- Finally, on the issue of *navigation safety aids* there is the Malacca Strait Council and the recently formed International Maritime Organisation's (IMO) Cooperative Mechanism built on three pillars - (1) a forum, (2) a fund, and (3) projects. Through the Malacca Strait Council, Japan was the only user State to contribute to the enhancement of navigational safety in the Straits and marine environment preservation until the establishment of the Cooperative Mechanism. Other user States that are now actively supporting projects are India, China, Australia, the US, Korea and the UAE. It took around 30 years for the Littoral States to agree to the scheme of the Cooperative Mechanism, which appears to be working well, but it is fragile. Funds are insufficient to replace and maintain navigation aid facilities, let alone modernise and upgrade them.

Generally, risks and costs do not seem to be borne fairly and equitably. Nonetheless, the aforementioned governance achievements are due to hard earned efforts of the negotiating nations, which should be applauded.

### 3.2 FOR INTERCONNECTED GLOBAL HUB-PORTS

The Port of Singapore is a globally-important transport and logistics hub. However, the emergence and growth of other hub-ports such as Shanghai and Busan has introduced a new era of inter-connected hub-ports where risks affecting one port can rapidly spread to others. For example, a mega-port that shuts down could cause re-routing of shipments and significantly affect the business of other ports. Whether the effects are positive or negative is still a matter of investigation, which is where the notion of "competitiveness risk" becomes important (see Section 2.4).

Risks affecting the competitiveness of ports aiming for hub-port status need to be taken seriously. It is possible that emerging mega-ports could weaken the Port of Singapore's competitiveness. On the other hand, with a strategy of cooperation to obtain mutual benefits, collective competitiveness could be fostered. Furthermore, as Asia quickly builds up its land transportation capacity, effectively generating east-west highways and land-bridges across the continent, Asian seaports may have a motivation to strengthen their collective competitiveness to remain important nodes in the logistics network of world trade. For example, the proposed link between the Andaman coast and the Gulf of Thailand (which would involve creating two new mega-ports) could have a serious impact on traffic through the Straits and vessel numbers using the Port of Singapore.

Addressing risks that can affect a range of interdependent ports requires regional and international cooperation, e.g., agreements on information-sharing, establishing early warning and monitoring systems, risk-sharing mechanisms and recovery

assistance strategies. These are needed in order to address the transboundary risks that would affect a group of ports indiscriminately and would impact negatively on the collective competitiveness of the group. While ports are under national control, there are interdependencies among them that need to be considered by a port's management, and perhaps collectively governed in order to address common threats and concerns emerging from the interactions between them.

Existing *multilateral frameworks* for maritime security include: the International Ship and Port Facility Security (ISPS) code; the IMO/ILO code of practice on security in ports; and, the World Customs Organization (WCO) "Framework of Standards to Secure and Facilitate Global Trade" (SAFE Framework). Several *regional frameworks* for enhancing maritime security are emerging, for example: the EC Regulation 725/2004 on enhancing ship and port facility security; Regulation 884/2005 laying down procedures for conducting Commission inspections in maritime security; Directive 2005/65/EC extending security measures from the ship-port interface to the entire port facility; the ASEAN/Japan Maritime Transport Security Program; and, the Secure Trade in the APEC Region (STAR) for Asia Pacific. The Secure Export Partnership (SEP) Scheme is part of New Zealand's bilateral agreement with the US on a Supply Chain Security Strategy in shipping goods to the US, which seeks to reduce risk through voluntary agreements with industry. Voluntary industry-led initiatives include: the ISO/PAS 28000 2005 standard (specification for security management systems for the supply chain); the Business anti-Smuggling Coalition (BASC) scheme; the Technology Asset Protection Association (TAPA) initiative; and a series of Partnership in Protection (PIP) arrangements.

### 3.3 FOR THE GLOBAL MARITIME LOGISTICS NETWORK INCLUDING HINTERLAND AND OTHER SUPPORTING INFRASTRUCTURE

Altogether, seen from the view of a network-of-networks, the Straits along with other critical sea corridors, global hub-ports with feeder ports around the world, as well as hinterland and other supporting infrastructure constitute the global maritime logistics network – a global critical infrastructure. This, in turn, is a macro-scale agglomeration of regional critical infrastructures (comprising nodes in the global critical infrastructure). At this level, the focus lies on the critical relationships between maritime corridors, hub-ports, feeder ports and the geographical, physical, logical and cyber interconnections with the hinterland infrastructure, including new technology, the local economy and society.

When discussing the critical position of the Straits, one participant questioned whether the Straits were in fact critical, given that several bypasses exist. The consensus was that despite the physical existence of bypasses, the Straits *are* critical because the logistics of bypassing the Straits are prohibitive in terms of distance, time (which is estimated at 2 to 3 days of delay) and costs. A study (presented by one of the participating organisations) suggested that bypassing the Straits would result in significant operational implications. For example, the capacity of shipping liners must match the port's capacity in order to be a viable alternative. Currently, the Lombok and Sunda Straits, which are potential alternatives to the Malacca Strait, do not have equivalent capacity. It would require heavy investment by industry and authorities to build up the required infrastructure.

The location of refineries and electric power facilities near ports presents a geographical interconnection between energy infrastructure and port and harbour infrastructure. The Port of Singapore is a case in point. Integrated air, land and sea

transportation leads to logistical interdependencies where timely deliveries depend on the reliability of the shipment's different transportation modes and the resilience of the integrated system. Advances in information technology and internet connectivity are changing how business is done and operations carried out in the maritime sector. Moreover, the Marine Electronic Highway (MEH) in the Straits of Malacca and Singapore is "an innovative marine information and infrastructure system that integrates environmental management and protection systems and maritime safety technologies for enhanced maritime services, higher navigational safety standards, integrated marine environment protection and sustainable development of coastal and marine resources" [UN, 2004]. Finally, non-traditional security problems, such as cyber attacks and unintended consequences of tighter integration and coupling of critical systems are threats to the maritime logistics network which should be concurrently addressed as greater integration and connectivity is put into place.

#### 4 PERSPECTIVES ON EXTREME HAZARDS AND THREATS

In the pre-assessment phase of risk governance, which precedes a formal risk appraisal, one needs to know the characteristics of the system under consideration in terms of structure, capacity, operations and functionalities. Considering the navigational characteristics in the Straits, the Maritime Institute of Malaysia (MIMA) identified six choke-points, as illustrated in Figure 3.

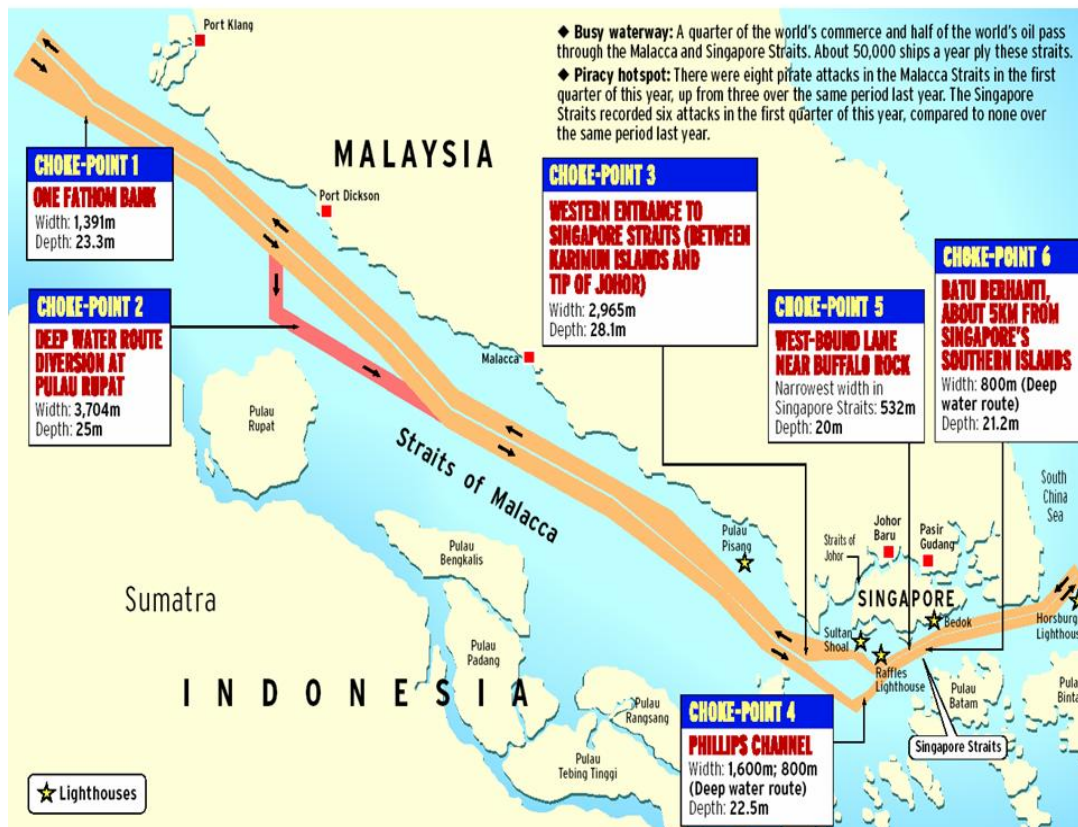


Figure 3: Possible "choke-points" identified in the Straits of Malacca and Singapore by MIMA (Figure courtesy of MIMA).

At each of these choke-points a risk assessment would be different, not only because the hazards are different but also because the impacts on the surrounding ports would be felt differently. For example, an accident at One Fathom Bank (choke point 1 in Figure 3) might block Port Klang, but it is possible that the Port of Singapore's

business could increase, whereas, any blockage in choke-points 3 to 6 in Figure 3 might completely paralyse the Port of Singapore's operations. Developing the knowledge to prevent any such occurrence would be of paramount importance. However, due to the national interests of Singapore, any research into the Port's vulnerabilities or the nature of hazards affecting its operations are not suitable for public domain publications. In effect, knowledge and information does not come freely and to protect the interests of various parties, sensitive information would need to be, in some manner, managed and controlled. Setting up an appropriate platform that is at once open and confidential is what the workshop attempted to achieve.

For the purposes of discussion, the risk areas identified as important to consider in more depth in risk assessments focused on the Straits included:

- collision (e.g. cross traffic and anchored ships);
- pollution;
- risks of exceeding the carrying capacity of the Straits;
- operational risks;
- transportation network risks;
- regional financial risks;
- navigational safety;
- security, including cyber and non-security (e.g. smuggling) risks;
- hazardous goods; and,
- robbery and piracy.

There is generally less concern about extreme natural hazards affecting the Straits because it is relatively sheltered and has had no past events of earthquakes or typhoons. However, the 2004 tsunami, which originated from an Indian Ocean earthquake and devastated Sumatra, Indonesia, showed that extreme natural events are not impossible. Thus ports and communities should be prepared for such a contingency, where contingency is defined as an unknown or uncertain event. There is also a need to consider all risks comprehensively and in an integrative manner, because of the possibility that some of these risks are related. The consideration of risk combinations could help develop synergistic risk management strategies that can address multiple risks at once. However, a method for framing, assessing, characterising and evaluating the interrelatedness among risks needs to be developed first. The following sections present perspectives shared during the workshop on natural hazards based on past experiences in Japan, Korea and China; on security threats such as terrorism in Mumbai, India; global warming; and, on the possible interconnections among these hazards.

#### 4.1 NATURAL HAZARDS

Major natural hazards considered during the workshop were earthquakes, tsunamis, typhoons, cyclones and sumatra squalls. Additionally, sea-level rise, wave-surges, and highly concentrated heavy rainfall were considered new threats related to climate change and meteorological conditions.

The occurrence and intensity of events is known to depend on geographical conditions. Seismology and meteorology provide the scientific basis for studying the underlying physical processes of earthquake effects and atmospheric weather effects, respectively, and for forecasting them. However, extreme natural hazards are

still very difficult to predict. Preparedness will be dependent on the availability and sophistication of technologies, e.g., gather and analyse seismic data to generate early warnings and alerts. But, well before an event is detected, infrastructure and procedures need to be firmly in place (to minimise damage) and first responders need to be prepared to act for a quick recovery, whether of economic, health or physical infrastructures. In the cases discussed – the 1959 Isewan typhoon, the 1995 Hanshin Awaji earthquake, the 2003 typhoon Maemi and the 2008 Wenchuan earthquake – recovery times varied and preparedness was described as generally poor. Many lessons were learned from these experiences and disaster prevention is now a high priority in these areas.

In the case of the 1959 Isewan typhoon, missing persons and human losses added up to 5,041 and the number of houses lost totaled 149,187. Heavy rain, heavy wind and tidal waves posed hazards to coastal infrastructures and supporting electric power infrastructures. One of the main problems was the loss of electricity to pumps needed for pumping out water and sand during flooding. The time required for recovery of electric power is dependent on the number of damaged distribution poles. Heavy rains caused damage to the river bank and tidal waves inundated the coastal areas causing further damage. Tides were measured at 5.31 meters at Nagoya Port which was 3.55 meters over the anticipated height. While other major typhoons occurred in 1934 and 1945, the Isewan typhoon was the most devastating ever experienced and made an impact on disaster prevention policies. Many of the port facilities were improved to specifications that would prevent similar damage from another Isewan-like typhoon.

The 1995 Hanshin Awaji earthquake, which basically shut down the Port of Kobe, caused damage to roads, bridges and water pipelines. Accessibility to the port and many of the artificial islands was the most important factor to recovery. Limitations on the transport capacity created shortages of essential supplies in hospitals, which were critical to caring for the injured. The shortages in supplies led to increases and worsening of injuries. In the short term, damages to port infrastructure were fixed. However, in the long term, business losses from re-routing were never fully recovered. Whereas the Port of Nagoya was necessary to local automotive and precision machining industries to import materials and export manufactured goods, Kobe's port was replaceable with alternative ports in Japan, China and Korea. Other ports in Asia are learning from Kobe's experience to secure their own survivability in the global maritime network.

In 2003, Typhoon Maemi caused 85 deaths, 25 reported missing persons, and the evacuation of 250,000 people. The total industrial losses amounted up to \$577 million (2003 USD), and also \$43 million (2003 USD) in agricultural damage. After typhoon Maemi, six out of seven cargo cranes had collapsed in the Shin-Gamman shipyard at Busan Port. The damages are under investigation and insurance claims are being contested in courts to determine whether they were caused by natural factors or whether they can be accounted for by human faults and poor construction. Based on a wind model, it is possible that some of the damage caused by typhoon Maemi was actually due to human fault rather than natural causes. On the other hand, Busan sits between mountains, which could make winds faster and stronger (much like how moving air is channelled and accelerated in an urban canyon). Gusts that were 1.5 times the speed of the mean wind speed were the likely cause of the destruction of the structures. While that matter is still in court, it is agreed that no preparedness programme was in place at the time of the incident. The workshop heard that the Busan Port Authority was not organised and the port was under the control of the central government until January 2004. The recovery time was relatively short because new container terminals at Qwangyang Port were under

construction and cranes were already constructed; those cranes were moved immediately to Busan to hasten its recovery.

Although the Wenchuan earthquake on May 12 2008 occurred inland, it provides some lessons on China's coping capacity which may be extrapolated to disaster risk governance in coastal areas. The Wenchuan earthquake was the most destructive in the history of the People's Republic, with the widest coverage, and posed the most difficulties for rescue and relief operations. The disaster effects were heavy casualties, numerous collapsed and damaged houses, heavy losses to the industry, heavy impact to people's livelihoods, large damage to ecological environment, and huge economic losses. It also caused large-area damage to infrastructure including expressways, railways, airports, power, communication, radio and television, water conservancy and pipelines. While there was no direct impact on port infrastructure, the response by the Chinese government provided the workshop with a good example of how the required awareness for disaster risk governance can proactively prevent and reduce disaster impacts. Despite identified weaknesses and shortcomings, those responsible were ultimately able to mobilise, organise and allocate resources in a timely manner. Using scientific assessment and a recovery and reconstruction programme aligned to legal responsibilities and newly-introduced regulations, rapid reconstruction was planned to be completed within three years. While the Chinese people should be proud of their achievements given the resources at hand, the workshop heard that they also must become more aware of disaster risk governance to be even better prepared in the future.

A few presenters offered some insights on the prediction of future extreme natural hazards, in particular those due to climate change. Based on one model presented, a future typhoon near the Korean peninsula could be intensified (e.g., lower central pressure, higher wind speeds and higher rainfall rates over greater areas). Based on another model with data from Osaka, the number of typhoons to hit Osaka is expected to decrease. However, the probability of extreme typhoon strength is greater in the future. Knowledge of other extreme weather events that are due to climate change (i.e., the explosively developing tropical cyclone, also referred to as "the bomb") is still insufficient and contains much uncertainty. It is, however, expected that warming will be more evident in polar regions. This will have the effect of moving typhoons northward, thereby having less effects on tropical Asia. Nonetheless, Sumatra squalls, which are thunderstorms characterised by very strong winds or squalls, are known to be hazardous in the Malacca Straits. Sumatra squalls are generally detectable three hours prior to occurring, allowing for ships to anchor themselves to brace the storm. While there is no clear evidence that the number and severity of extreme natural hazards is increasing in the region of the Straits, it may be prudent to take this opportunity to be proactive and prepared for the "impossible".

## 4.2 SECURITY THREATS

Although extreme natural hazards are rarely on the radar in the Straits, there is a plethora of security issues which are, for the most part, non-traditional emerging security threats that cannot be handled by traditional military force. In any case, the openness of the Straits and the sovereignty of the Littoral States generally discourage unilateral military interventions as they would negate the international conventions of and freedoms enjoyed in the Straits. Instead, security threats must be handled by international agreement and cooperation on rules and regulations as well as on management and operational procedures. These security threats include terrorism, robbery and piracy, and the smuggling of illegal cargo including transportation of weapons of mass destruction. These threats are heightened by increasing traffic, larger ships and high-value cargo. These are not necessarily new

risks in the sense that governments have been concerned about them for quite some time, but the conditions appear to be changing and the sophistication of perpetrators evolving.

Terrorists, pirates and smugglers may take advantage of the vulnerabilities in the Straits. Predicting their activities is very different from predicting a typhoon as their plans are intentionally uncertain and unclear to reduce the possibilities of being detected and caught. The Mumbai, India, terrorist attacks were planned to meticulous detail and executed with precision using sophisticated satellite location maps, satellite phones, modern weapons and highly destructive RDX explosives. They targeted the vital transportation systems, including the main railway station and seaport, as well as city landmarks, a major hospital and areas as close to the airport as they could get. The terrorists' communication and coordination was much more high-tech than that of the government. Hence, Mumbai was not sufficiently prepared. The workshop judged it very likely that the government of Singapore is very aware of the threat of terrorism and that measures are in place to guard intelligence on port infrastructure and that operations are in place to manage the threat. Of course, since the goal of attacks is to create panic and disruption, any free media that exposes the vulnerabilities of ports may be ill-advised.

Dealing with pirates and smugglers is a completely different matter, but similarly requires cooperation and coordination among the Littoral States. Eliminating the opportunities for unauthorised boarding of vessels by maintaining vigilant patrols and encouraging the continuous flow of traffic (i.e., discouraging anchoring) should be supported not only by the Littoral States, but also the shipping industry (particularly ship owners, managers and shipmasters). As for smuggling, port authorities generally can only exercise jurisdiction on goods and people that are landed. Transshipments, on the other hand, do not need to be declared, despite the fact that their access to land provides the opportunity to unload illegal cargo. Whether all goods passing through the Straits should be declared or not is a matter of international convention. The trade-offs between security and costs to the ports and to business would need to be evaluated.

In order to effectively deflate these security threats, there is a need to allocate resources strategically, prioritise actions and involve not only the responsible public authorities but also industries and other stakeholders. Getting to the root causes of these threats, which may be political and social in nature, should also be a part of the risk governance process. Tremendous changes in government and institutions may be needed to adapt to man-made hazards, there is also a need to develop the capacity to continuously learn and evolve. Moreover, more pervasive use of modern ICT will introduce new risks including common mode failures and entry points for cyber attacks. One needs to be more knowledgeable, better organised and trained to have any chance against an equally-intelligent adversary. While the development of knowledge is clearly needed, it is also important to consider how this knowledge, particularly the information that is shared within a group, should be protected.

#### 4.3 CONCERNS REGARDING INTERCONNECTIONS BETWEEN NATURAL AND MAN-MADE HAZARDS

Definite concern was expressed during the workshop on the possibility of "Black Swan" [Taleb, 2007] events (i.e. surprises, or "unknown unknowns"). More predictable developments (i.e. increasing traffic in the Straits and proportionate increasing probability of accidents) have produced risk governance mechanisms such as the Traffic Separation Schemes (TSS) – a routing system for more orderly

traffic flow - and STRAITREP – a mandatory ship reporting system for improved navigation, safety and environmental protection. One participant argued that it is unlikely that countries in the Straits have the capacity to handle such a low-probability / high-impact event as an oil spill the size of that from the Exxon Valdez. Given the size of Malacca-max ships and single-hull design, there is a “disaster waiting to happen”. Imagining worst-case scenarios is one strategy in pre-assessment and risk appraisal for increasing resilience and preparedness for low-probability / high-impact events.

Vulnerability assessment is the tool of choice because unknown risks are unquantifiable. The focus of discussions was on vulnerabilities from exceeding the carrying capacity of the Straits, from urbanisation, which is accompanied by ecological effects of deforestation and ruined wetlands, and from climate-related effects of sea-level rise, flooding and water-logging in low-lying coastal areas. Human activities can be shown to have decreased the resilience of the natural environment, thereby worsening the impacts of natural hazards. Disasters are further compounded by negligence leading to poor planning and construction, misunderstandings (e.g. dumping waste into the Straits and burning fires that worsen haze days), miscommunication and lack of training and preparedness. One must also consider the inability to change behaviour (c.f. ongoing efforts to address the causes of global warming) and how governments can erect barriers to disaster relief (e.g. for disaster victims of 2008 cyclone in Myanmar). Whether they be "Black Swan" events or imagineable hazards, either of which are by definition hypothetical, hybrid crises can also still be imagined; again, using vulnerability assessment offers a means to manage such threats to the maritime global critical infrastructure.

## 5 PROJECTION OF CONSEQUENCES

A risk assessment involves the identification and characterisation of a risk, including the probability of occurrence and an estimation of the degree of damage and disruption. An impact assessment projects the short-term and long-term effects on populations, economies, environments and other systems of importance. The potential consequences of taking a risk or of ignoring a risk should factor into risk management. Projecting major consequences is an area with current knowledge gaps and where intensive research is needed to inform risk-related decisions. Furthermore, it is imperative that models are validated with data from actual experiences, in order to ensure that sound scientific evidence is presented.

Knowing the consequences of an event requires knowledge of cause and effect relationships. Damage categories (consequences) include human lives and health, ecological stress on mangroves and other biologically diverse ecosystems, economic assets, livelihoods in terms of fisheries and subsistence, and interruption of trade leading to societal ramifications. These are difficult to establish when risk problems are complex, uncertain or ambiguous, which makes scientific risk assessments challenging and debatable. It is generally agreed that potential losses in coastal areas would be higher than inland, due to the concentration of values in terms of economic trade, value per space (value density), and urbanisation. The difficulties in assessing the consequences of extreme events for the maritime global critical infrastructure are explored in the next sections along with strategies that may be suited to overcome them.

### 5.1 KNOWLEDGE CHARACTERISTICS IN RISK GOVERNANCE OF THE MARITIME GLOBAL CRITICAL INFRASTRUCTURE

In IRGC's risk governance framework, the knowledge derived from risk assessments should be subject to a knowledge "challenge" intended to assess that knowledge's complexity, uncertainty and ambiguity and to establish which of these characteristics is dominant.

**Complexity** refers to the difficulty of identifying and quantifying causal links between a multitude of potential causal agents and specific observed effects [IRGC, 2005]. Interactions and interdependencies among variables may result in overwhelming complexity. Modelling and analysis can be made manageable by narrowing the scope, omitting negligible variables or considering fewer cases. In one workshop session, a model was presented that simulates international cargo flow. Nine carrier groups (alliances) were assumed, where, in reality, hundreds of shipping lines and carriers exist, thereby creating a very complex, dynamic environment. Although not a perfect reflection of reality, the model's assumptions should be scrutinised in order to judge its merit. Assuming nine carrier groups may be very reasonable if the industry is in fact basically dominated by these alliances and unlikely to change. Otherwise, more analyses that cover a broader set of assumptions may be necessary in order to draw out patterns and trends so that robust risk management strategies and policy options can be designed to reflect actual operating conditions.

**Uncertainty** exists when adverse effects, or the likelihood of these effects occurring, are not precisely understood [IRGC, 2005]. The degree of service-level reduction, economic disruption and long-term losses in business due to a port shutdown may be uncertain. Where emergency response, recovery and reconstruction programmes are not in place, impacts may be uncertain because people's reactions are unpredictable.

Impacts may be more predictable if disaster preparedness and planning are in place because courses of action are known ahead of time. However, consequences may still be uncertain due to a large range of plausible futures ("scenarios") which could change the course of events. For example, there are large differences in consequences when a typhoon takes a different track, which could happen as a result of a number of different factors including temperature and atmospheric conditions. Furthermore, the consequences of impacts can vary widely as a result of different decision-making options available to shipping companies, port authorities and other decision-makers. As uncertainty in knowledge makes it difficult to contain risks – and perhaps also limit the propagation of risk – more focus should be put on reducing vulnerabilities, increasing resilience and building capacity to quickly adapt to changing circumstances.

Finally, **ambiguity** characterises the knowledge for which interpretations of data and analyses are conflicting due to different risk perceptions, value systems or interests. For example, safety can be a relative term. Shipmasters who are very comfortable with the geography of the Straits and skilled in manoeuvres to ward off unauthorised boarding of their vessels may view the risks of collisions and robbery to be individually manageable. In their view, the best solution to reducing these risks may not be to increase investment on expensive navigation aids nor to step up patrols in the Straits but, rather, to have better-trained shipmasters who know their surroundings and are more capable of maintaining control of their ship. From an environmental perspective it may be argued that certain circumstances are unavoidable, in which case more support should be available rather than solely relying on the capabilities of the shipmaster and crew. From a social perspective, the creation of higher-paying jobs in Indonesia may be argued as a better investment than increasing patrols to reduce robbery in the Straits. The beauty of ambiguity is that nobody is definitively wrong. Win-win solutions may therefore be reachable, although it will take discourse to negotiate the terms of agreement and to create conditions for mutual benefits.

## 5.2 KNOWLEDGE GAPS IN RISK GOVERNANCE OF THE MARITIME GLOBAL CRITICAL INFRASTRUCTURE

During the workshop, knowledge gaps were identified as belonging to three classes of issues: (1) *daily operational issues*, (2) *natural hazard and security issues* and (3) *global critical infrastructure interdependency issues*. Identification of knowledge gaps was attempted by looking at the effectiveness of coping strategies to these classes of issues.

With respect to day-to-day navigation in the Straits, it is recognised that human error is one of the major causes of accidents. Unawareness of daily hazards by ship officers is one of the knowledge gaps which the Maritime Port Authority (MPA) of Singapore is proactively addressing by offering training courses. As for maintaining the navigational aid facilities in the Straits, which have daily operational safety implications, it is a continuous challenge to get damaged facilities fixed. The problem is that costs are not being borne fairly between, on one hand, the Littoral States and, on the other hand, users of the Straits. Knowledge gaps exist on how to convince other governments and Straits users to participate in maintaining and upgrading these facilities, what the roles and responsibilities of each may be, and how the cost can be shared equitably.

On reflection of natural hazard risks and security issues, the Straits have been lucky enough not to have experienced a major disaster. However, given the scale of

bunkering and the location of refineries and chemical plants near the coast, potential disasters affecting these should be matters of real concern, to both the government of Singapore and the oil and shipping industries. The insights learned from Mumbai International Airport provided a model of how coping strategies are built into the day-to-day operations at the airport. All agencies at the airport undergo annual mock scenarios in which a security threat is played out. After the run-through, drawbacks are identified and shared amongst all of the agencies, which are then given six months to address the drawbacks. All agencies reconvene after six months to judge whether the drawbacks have been addressed. Furthermore, each month, a dry-run is set up wherein an actual hazard (e.g., a fire) is realised. Staff undergo the drills and procedures that are planned and prepared for such an occurrence and are evaluated on their performance.

Finally, on interdependency issues in the maritime global critical infrastructure, workshop participants explored coping strategies of interdependent critical infrastructures and the possible use of financial risk management instruments. The efficient functioning of the maritime global critical infrastructure is dependent upon other critical infrastructures. While there is awareness of the interdependencies between port and electric power infrastructures, the models and simulations of the Central Research Institute of Electric Power Industry (CRIEPI) are in the process of being built up and validated against case studies. The dominant issues are not yet known. With regard to risk management in times of disaster, both financial and social capital is important to reduce recovery time and minimise losses. The reinsurance industry is designing and implementing various natural catastrophe (Nat-Cat) financing mechanisms so that times of distress can be counter-acted with the required financial resources. For these products to be financially viable, however, there is a need for reliable indices or parameters to characterise the risks of losses at nodes in a network, which are connected to a hazard-source node. Another financial instrument, Cat-bonds, were considered potential mechanisms to protect against interdependent security issues. However, further investigation is needed to understand exactly how they would work in a large-scale network.

Altogether the knowledge gaps are many and, in order to advance knowledge development, the workshop participants suggested creating technical research and practical applications subgroups. Their aim would be to focus the research problems further, develop analytical tools and instruments to address these problems directly, and to communicate research results and findings to the broader group of stakeholders.

## 6 LEGAL, INSTITUTIONAL AND ORGANISATIONAL CAPACITIES

In addition to the need to develop a common language and knowledge, the workshop also identified strategic timing of decisions, actions and policy initiatives as a key element for achieving good risk governance. This aspect is dependent on the legal, institutional and organisational capacities of agencies from all sectors (public, private and civil) and governance levels (local, national, regional and international). These capacities, and in some cases deficits in them, influence the outcome of disasters whether or not a disaster preparedness plan is in place. Factors that affect strategic timing are perception, funding and coordination among decision-makers. If an event is perceived of as high-risk, there may be more motivation to act quickly and proactively and to allocate adequate financial resources to preparedness measures. When funding is low, the ability to build up capacity is constrained. Finally, coordination is needed for resource mobilisation, backing up international agreements with national legislation, and consolidation of the capabilities of multiple agencies so that synergistic strategies emerge.

In considering the legal, institutional and organisational capacities for good risk governance in the Straits, there are many issues that are geopolitically, historically and culturally sensitive. Even though there are some voluntary initiatives (i.e. the Malacca Strait Council<sup>3</sup>) there are few formalised methods to establish governance structures at the international level. How might agencies be able to work together? Who is going to carry out the work in the risk governance process? What support is needed to aid risk managers, emergency planners, staff and crews to handle their risks effectively? In order to see the deficits in legal and institutional frameworks, one needs to envisage an ideal future and establish what is needed to get there.

In the following sections the UN Convention on the Law of the Sea (UNCLOS), which is the fundamental legal framework for international maritime affairs, is presented as an illustration of what was described at the workshop as the “anarchical” nature of international relations in the Straits. Next, a survey of the sensitive issues that make governance in the Straits exceptionally challenging is provided. Finally, alignment with other international initiatives, such as the IMO Cooperative mechanism, provides an opportunity to gain momentum on this front.

### 6.1 UN CONVENTION ON THE LAW OF THE SEA

The 1982 UNCLOS was a seminal achievement in modern international law, which provided an international regime over oceans and seas that were clearly beyond national jurisdictions. It is a framework that is based on the principles of the freedom of the seas and the common heritage of mankind. Hence, no single entity is empowered to either govern, or solely benefit from, international waters.

The framework of the UNCLOS provides legal support for open international navigation in straits that are bordered by more than one country and for cooperation among bordering States and user States for safe navigation and protection of the environment. The IMO Cooperative Mechanism, agreed to by the three Littoral States of the Straits and a few user States, including Japan, Korea, China, India, Australia, US and UAE, is a practical implementation of Article 43 which states [UN, 1982]:

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<sup>3</sup> The Malacca Strait Council, which preceded the UNCLOS, was already an initiative of cooperation that recognised needs and desires of the Littoral States and Japan to enhance navigational safety and prevent environmental pollution in the Straits.

"User States and States bordering a strait should by agreement cooperate:

(a) in the establishment and maintenance in a strait of necessary navigational and safety aids or other improvements in aid of international navigation; and

(b) for the prevention, reduction and control of pollution from ships."

While the UNCLOS is a legal document, the wording of Article 43 suggests that this part of the framework is more of a suggestion than a requirement because there is no way to actually force the process of agreement. In a sense, the relations in the governance of straits among bordering and user States are fundamentally of an anarchical nature [Bull, 1977] and can only be orderly and agreed to through negotiations rather than by rule of law. The Cooperative Mechanism provides a forum for Littoral and user States and the shipping industry to meet on a regular basis to discuss safety, security and environmental protection. The mechanism also consists of project committees to initiate projects for maintaining safety and openness of the Straits and cost-sharing of projects. In order to be more effective, the Cooperative Mechanism needs continuous momentum, a broader view on potential hazards and consequences, as well as a broader basis of support from user States and the shipping industry.

## 6.2 THE ISSUES

In the workshop, the sovereignty of the Littoral States was considered the most important challenge to achieving cooperation and coordination in governing the Straits. Any actions that could be viewed as threatening national sovereignty was perceived as having little or no chance of being accepted, especially by Malaysia and Indonesia. Direct funding from governments to projects poses a problem, thus third party foundations such as the Nippon Foundation are important actors because of their financial contributions. User countries cannot be seen as directly controlling a project but, rather, play a supportive role through offering expertise in technology or human resources. Despite the fact that management of the Cooperative Mechanism rotates amongst the three Littoral States for 3-year terms, there is still uncertainty regarding who is, or should be, in control. The roles of governments may need to be formally clarified in a more formal way, because minor issues could be misinterpreted as political affronts threatening national sovereignty. Third-party project managers, such as foundations, may be needed to relax the political tensions that surround the Straits. In fact, Valencia suggests in his article "a coordinating committee to solicit and select appropriate projects including training and capacity building, collect funds, enhance efficiency, eliminate redundancy, monitor and report on project implementation, collect and disseminate information, and share intelligence" [Valencia, 2006a]. Something akin to this committee may indeed be helpful, while keeping in mind that all stakeholders should be involved in its development to ensure accountability.

Discussion at the workshop identified a number of other issues that would help participants understand the difficulties of governance: the historical relations and cultural differences among the countries bordering the Straits; the importance of consensus building; problems of economic inequities and differences in the pace of development within the region; free riding as an inevitable problem in the provision of public goods; and, a lack of international financing. These issues may need to be considered further in order to determine the most effective strategies to overcome them.

### 6.3 IMO COOPERATIVE MECHANISM AND OTHER INTERNATIONAL INITIATIVES

One of the most resonant statements made during the workshop was that the group does not want to reinvent the wheel. The IMO Cooperative Mechanism took 30 years to be established and has been agreed to by the three Littoral States. It needs to be built upon and expanded to become an inclusive and comprehensive framework for multilateral governance in the Straits. The dimensions of risk governance, along with disaster prevention and reduction, can be included in this framework; however, it will require a great deal of work and strategic timing by this project's partners – and others – to put it on the agenda.

The IMO and the UN are not unfamiliar with the importance of risk assessment and disaster management. The IMO has set out a Formal Safety Analysis (FSA) procedure as a tool in the maritime rulemaking process. It is a proactive approach to identify cost-effective risk reduction options and includes five basic steps of (1) hazard identification – list of accident scenarios, (2) risk analysis – probability and consequences, (3) risk control options, (4) cost benefit assessment and (5) recommendations. In addition, the UN's International Strategy for Disaster Reduction is a global effort towards the goals of reducing the loss of lives, the socio-economic setbacks and the environmental damages caused by natural hazards. These initiatives are also potential areas where risk governance should be prominently placed.

In order to align with these international initiatives, a clear and focused mission, plan of action and strategies is needed to guide workshop participants in their future efforts to explore and recommend improvements to the risk governance of the maritime global critical infrastructure (and possibly, in future, global critical infrastructures in general).

## 7 IMPLICATIONS FOR RISK GOVERNANCE OF THE MARITIME GLOBAL CRITICAL INFRASTRUCTURE

Based on the presentations and discussions during the workshop, the current issues in risk governance of the maritime global critical infrastructure are listed below. They are organised according to the phases of IRGC's risk governance framework so that further discussions may be similarly structured. In the working group sessions participants were asked to brainstorm in small groups on what the future of the overall group might look like and what the long-term policy impacts of its work might be. A list of preliminary recommendations is also provided below. The recommendations are primarily intended for workshop participants and other stakeholders who will be involved in the second phase of this project.

### 7.1 ISSUES

#### PRE-ASSESSMENT

- There are various dimensions of risk and crucial governance issues in the Straits of Malacca and Singapore, but the framing of the problems is currently too limited. This workshop was the first attempt to frame potential problems in the global maritime critical infrastructure more comprehensively and, in a broader context, to consider extreme risks and hazards. At the same time, care should be taken to focus the problem areas so that there is a clear direction in what the group is trying to accomplish.
- Early warning systems of tsunamis, earthquakes, typhoons and other weather hazards exist where there is a history of past events and financial backing to maintain and upgrade these systems. However, events such as the 2004 tsunami showed that these systems are rarely in place in developing countries, where vulnerability is high and financial resources lacking.
- The current focus of safety and security measures is on avoiding collisions, piracy and associated pollution from ships. Other threats on the horizon include: extreme natural hazards (of limited importance for the Straits but very important for some of the key global hubs); man-made disasters, including accidents in nearby hazardous facilities (e.g., chemical plants, refineries); malicious attacks by terrorists, cyber terrorists and dissatisfied individuals; and potential "surprises" including those due to the complexity and pervasive use of modern ICT. Preliminary assessments of new threats are required, but it is not yet determined how and by whom they should be carried out.
- Current paradigms for handling risk are generally focused on short-term, local competitiveness potentially affected by disaster risks. This mindset needs to be revisited and potentially expanded to foresee long-term collective competitiveness risks. Individual interests may be balanced by a kind of supra-national, trans-sector solidarity.

#### RISK APPRAISAL

- As a general comment on the availability of tools and analytical instruments for risk appraisal, there is an absence of appropriate methods to deal with global critical infrastructures as complex systems. There is a gap between scientific risk assessment and concern assessment. Involving stakeholders is a continuous challenge. Various techniques exist for conflict resolution, group decision making and negotiation, and these techniques may fit into the risk governance framework as a basis for concern assessments.

- There are both physical and psychological dimensions of risks. Risk perceptions drive behaviour but are not often well understood.
- Development of global social capital and trust was pointed out as a key to success in the risk governance process. Trust is generally built upon credibility, honesty and transparency. When it comes to addressing security and sovereignty issues and related risks at the international level, very little trust has been established. The design of scientific risk and concern assessments, as well as information sharing networks, may need to take into consideration the need to build up trust in order to obtain and distribute credible information.

#### RISK CHARACTERISATION AND EVALUATION

- Selecting appropriate criteria for characterising risks, vulnerabilities and concerns requires value judgements. At this point, a potential issue might be the lack of consideration of or balance between public and private interests. When forging public-private partnerships, methods that lead to win-win resolutions are needed.
- Decisions based on consensus are highly valued in Eastern cultures, as opposed to the "majority rules" mentality of Western cultures. Indecision may therefore be an issue in this phase of the risk governance process. Formal consensus-building tools are needed to ensure that everyone is satisfied and feel that they are part of the process.

#### RISK MANAGEMENT

- For risks with potentially global impacts, a key issue is determining who is responsible for global risk management. Essentially, each individual is responsible for managing risks within their own control. However, global risks are not generally within the control of separate individuals but are, rather, a systemic issue affecting and influenced by an interconnected network of individuals and groups. For this reason, it appears imperative that organisations and individuals associated with the maritime global critical infrastructure work together as a cohesive group to manage the risks.
- In order to achieve the well-planned and sustainable implementation of risk management, commitment to a vision and stakeholder buy-in is necessary. This means that, from the outset of the risk governance process, it is important to attract the interests of governments, industries and communities. Without balanced input to the risk management phase, issues of inequity and accountability could proliferate. For comprehensive security in the Straits, the shipping and other coastal industries, port authorities and governments of Littoral States and user States, as well as fishing and local communities, will each have their set of roles and responsibilities.

#### RISK COMMUNICATION

- As mentioned throughout this report, solving the problem of risk communication was at the core of the objectives of this workshop. In general, there has been a lack of communication between researchers and policymakers. Now that decision-making based on sound scientific risk assessments and evidence is sought, opening up the communication pathways between the realms of knowledge generations, decisions and actions is the current challenge.

## 7.2 POTENTIAL RESEARCH AND ACTIONS TO EXPLORE

### PRE-ASSESSMENT

- Pre-screening activities should consider a broadened spectrum of threats and hazards, as well as the vulnerabilities of interdependent elements of the maritime global critical infrastructure.
- Learn more on risk framing and how to utilise multiple frames to define problems.
- Acquire more knowledge through preliminary assessments to determine the dominant threats and to prioritise areas of further research.
- Develop guiding instruments such as a mission statement, a vision statement, a map of problem foci and a plan.
- Get buy-in from all stakeholders by touching on their interests and presenting them with a vision on where they might fit into the big picture of risk governance of the maritime global critical infrastructure. Ask them where they see themselves fitting in and attempt to come to an agreement on potential partnerships in the future.

### RISK APPRAISAL

- Develop, implement and validate analytical assessment tools for risk, vulnerability and concern assessments.
- Build trust and social capital by involving stakeholders, paying close attention to their interests, values and belief systems and risk perceptions.
- Recruit champions from each sector and each level of governance to aid in building good relations among the diverse set of stakeholders.
- Carry out scientific risk assessments, vulnerability and concern assessment in an integrative way. Construct scenarios with various elements and dimensions.

### RISK CHARACTERISATION AND EVALUATION

- Utilise group decision-making and negotiation techniques to acquire appropriate criteria and measures to characterise and evaluate the risks.
- Evaluate the balance of representation of important stakeholders.
- Build up tools and methodologies for consensus building by analysing the factors which stagnate the decision making process.

### RISK MANAGEMENT

- Utilise what is already in place and further develop towards a more global view, overcoming free riding and spreading adequate awareness.
- Assign roles and responsibilities that are suited to an entity's interests and capabilities. Get participation of industry.
- Differentiate between local and global issues and the interconnections among them.
- Undertake a pilot study to attract attention.

### RISK COMMUNICATION

- Design and implement new communication network structures including physical and virtual meetings.
- Develop communication channels to decision-makers and funders.
- Develop and extend a professional and unique network and committee for addressing risk-related problems of the maritime global critical infrastructure.

### 7.3 LONG-TERM POLICY IMPACTS

As for the long-term policy impacts for the risk governance of the maritime global critical infrastructure, it is hoped that this group of participants, while focussing mainly on the case of the Straits of Malacca and Singapore, can also develop strategies and recommendations that are applicable to the maritime global critical infrastructure in general. The main policy focus is on effective communication for regional and global risk governance. It is felt that the largest contribution will be to heighten the capacity to cooperate and to take initiative among different organisations.

IRGC's risk governance framework provides a structure for the risk governance process. Along with conflict resolution to facilitate consensus building, the framework could be well suited to an Eastern context. What will be needed from the participants is building awareness on what risk governance is and how best to achieve good risk governance. These issues were discussed in the workshop and seem to be understood by the group. However, it is unlikely that they are yet known or understood to be different from conventional risk assessments in policy arenas and among the general public.

Another possible role for the participants is to provide advice from an independent third-party perspective on: the priority areas within the maritime global critical infrastructure; who should be involved if anything is to be taken seriously; and, how to get the conversation started and maintained so that it leads to international and inter-sectoral agreements and decisive actions to implement them. In order to have a long-term policy impact, the results of this project need to be widely disseminated to all relevant stakeholders and carried over to (an) existing organisation(s) working in the field of maritime global critical infrastructure.

### 7.4 CONCLUSIONS

This summary report of the IRGC-GCOE-KU International Workshop on Risk Governance of the Maritime Global Critical Infrastructure: Straits of Malacca and Singapore Exposed to Extreme Hazards, presents the insights and information that were shared during the workshop. Based on the workshop's discussions, issues in risk governance of the maritime global critical infrastructure were extrapolated and potential research actions to explore were also listed.

We know that there is an important need for improvements to the risk governance of critical infrastructures, in which disruption or failure could lead to major consequences on trade, the economy and other critical infrastructures through interdependent relationships. Impacts will be local, regional as well as global. Regional and global impacts are of particular concern because there is no formal government or governance structure to address transboundary risks.

Key governance issues are a lack of transboundary (national-international) legal and organisational frameworks, a lack of comprehensiveness and sufficiently broad focus, a lack of integration and the need for a new paradigm such as some sort of solidarity or public-private partnerships instead of a pure pro-business environment approach. The largest issues were identified as lack of stakeholder participation for which the recommendation is to carefully construct an information-sharing communication network through which effective risk governance may be achieved.

It was hoped that the workshop would act as a launching platform for continuous dialogue and that by maintaining momentum from the workshop it would be easier to

get relevant stakeholders involved. It is recognised that there are already certain mechanisms and initiatives in place, but it is also believed that this group can contribute tremendously to the enhancement of such mechanisms and initiatives as well as the advancement of risk governance and disaster reduction and prevention in the maritime global critical infrastructure, which is currently not a niche focus of any of the other initiatives but sorely needed to tackle emerging global problems.

## 7.5 WHERE TO NEXT?

Thanks to the enthusiasm of the participants, there is a resounding agreement to reconvene in 2010 to share new knowledge, evaluate progress and continue the dialogues as the situations adapt, emerging threats evolve and new threats surface. But before that second meeting, it was desired that work be done in between meetings so that it can focus on making progress towards the desired long-term policy impacts.

Two participants offered to be the next meeting chairs and offered Busan, Korea and Shanghai, China, as potential locations for the 2010 meeting. Another two participants volunteered to lead the Singapore/Indonesia/Malaysia vision subgroup wherein preparatory work for the next meeting would be undertaken. An Indonesian counterpart would of course be recruited. With the support of another participant as leader of the research subgroup and another as the leader of the practical applications subgroup, further refinement of problem framing and pre-assessments would be undertaken to more precisely define the niche of this group and to attract participation from all stakeholders involved in the maritime global critical infrastructure. Meanwhile, the Kyoto workshop's organiser will continue his efforts to build the network to involve related industries, foundations, government officers and other excellent researchers.

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## APPENDIX I: WORKSHOP PROGRAMME

### **IRGC-GCOE-KU International Workshop on Risk Governance of the Maritime Global Critical Infrastructure: Straits of Malacca and Singapore Exposed to Extreme Hazards**

Kyoto University, Kyoto, Japan

4-5 June 2009

#### **Workshop objectives:**

- To address vulnerabilities of major straits and interdependent global hubs closely linked to international maritime transport networks, all susceptible to extreme natural hazards
- To bring these vulnerabilities into perspective with other malevolent events/malicious attacks
- To examine possible consequences of those events causing paralysis of national/global transport infrastructures and harm to economy
- To assess the state of knowledge and analytical instruments
- To assess recovery concepts/strategies and the role of hinterland support infrastructure
- To reflect on existing legal/organisational frameworks and integrated governance concepts and to identify deficits where appropriate
- To develop risk governance recommendations for policymakers and decision support needs.

#### **Focus:**

- Integrated disaster risk governance issues of the Straits of Malacca and Singapore linked to transport networks and interdependent global hubs in South East Asia and their hinterland infrastructure
- (Emerging) threats of catastrophic tropical storms, earthquakes/tsunamis as extreme natural events comparing them with other man-made or natural threats.

#### **Outcomes:**

- Initiated or fostered dialogue among key stakeholders
- Shared views on the scope of the problem and a priority list of necessary actions to cope with the multiple hazards and threats including risk appraisal and concern assessment
- Better understanding of the challenges to risk governance strategies based on thorough analysis of the systems in place (capacities and deficits)
- IRGC summary report and policy brief containing risk governance recommendations.

#### **Modus operandi:**

- Provide a platform for global multi-stakeholder dialogue with about 30 participants from regulators, foundations and research, etc. from S. Korea (Busan), China (Shanghai/Shenzhen), Malaysia, Singapore, Japan (Kyoto, Tokyo, Kobe, Nagoya), India (Mumbai), Germany, Switzerland, etc. as well as from global industries (port, shipping, insurance).

- Devote sufficient time for intensive open discussion, knowledge sharing and the development of ideas for improving risk governance by applying a panel approach and the Chatham House Rule
- Facilitate discussion by sending a briefing document based on the application of IRGC Risk Governance Framework in advance to all participants
- Summary report drafted by the organisers and commented/agreed by the participants

**Agenda:**

<b>DAY 1 Agenda</b>	
<b>Thursday, 4 June 2009</b>	
<b>Kyoto Terrsa, East Building, 2nd Floor, Seminar Room #3</b>	
<b>Time</b>	<b>Session</b>
8:30	Registration
9:00	Welcoming remarks by organisers and hosting organisations
9:30	Introduction and discussion on briefing document
10:30	Keynote: Crucial governance issues of the Straits of Malacca and Singapore Q/A and Discussion
	Risk Assessment and Governance Issues of the Straits of Malacca and Singapore
	Risk Assessment and Policy Options for the Straits of Malacca
	Japan and the Cooperative Mechanism on the Straits of Malacca and Singapore
13:00	LUNCH
14:30	Panel 1: Learning from major earthquakes, tsunamis and tropical storms - Framing hazards and vulnerabilities with wide-area consequences Q/A and Discussion
	Lessons Learned from the Isewan Typhoon and Kobe Earthquake: From the Perspective of Supporting Infrastructures for Ports and Harbors
	Review of Typhoon "Mae-mi" in 2003 and Its Impacts on Port Facilities
	Experiences and Lessons of Large-Scale Disaster Governance in China • Perspective to the Response of Wenchuan Earthquake Disaster
	Safe Navigation in the Singapore Strait
	Terror Attacks in Mumbai: A New Dimension to Disaster in Context of Critical Infrastructure, Perspectives and Prognosis for the City
	Forecast and Stochastic Modeling of Future Typhoons based on GCM Projections
16:35	BREAK

<b>DAY 1 Agenda</b>	
<b>Thursday, 4 June 2009</b>	
<b>Kyoto Terrsa, East Building, 2nd Floor, Seminar Room #3</b>	
<b>Time</b>	<b>Session</b>
16:45	Panel 2: Looking beyond the horizon - Reflections on foreseeable developments, potential scenarios and knowledge gaps Q/A and Discussion
	The Scenario Simulation and Risk Analysis of Waterlogging and Typhoon from Coastal City, Shanghai
	Possible Meteorological Threats to Maritime Transportation
	Past, Present, and Future of Busan Port and Its Disaster Prevention Program
	50 Years of Disaster Prevention in Nagoya Port since the 1959 Ise-wan Typhoon
	Risk Accompanied by a Coastal and Rapid Urbanisation Region • Shenzhen Case
	The Issues of Shutdown of Gateway Port: The Case of Eastern Asia
18:30	ADJOURN
19:00 - 21:30	Reception and Dinner

<b>DAY 2 Agenda</b>	
<b>Friday, 5 June 2009</b>	
<b>Tale of Genji Museum, Conference Room</b>	
<b>Time</b>	<b>Session</b>
8:45	Registration
9:00	Welcoming remarks by Tale of Genji Museum hosts
9:15	Working session: risk governance and related concepts/strategies Brainstorming and Discussion
10:45	BREAK
11:15	Panel 3: Assuming "the impossible" - Reflections on adequacy and resilience of coping mechanisms Q/A and Discussion

<b>DAY 2 Agenda</b>	
<b>Friday, 5 June 2009</b>	
<b>Tale of Genji Museum, Conference Room</b>	
<b>Time</b>	<b>Session</b>
	Risk Scenario Analysis in Southeast Asia: Policy Implications of a Blocked Malacca Strait
	Lessons from the 2004 Indian Ocean Tsunami and Possibilities of Tsunami in the Region of the Malacca Straits
	Interdependencies between Ports and Electric Power Critical Infrastructures
	Interdependent Security Problems in Maritime Global Critical Infrastructures
	Nat-cat Risk Management & EQ Risk Finance
	Related Security Issues of Man-made Disasters and Potential Extension to Airport Global Critical Infrastructures - An Insight at CSIA
12:45	LUNCH
13:45	Panel 4: Viewing legal, institutional, organisational issues - Exploring the need for a new initiative and paradigm Q/A and Discussion
	Critical Infrastructure Protection and Collaborative Emergency Management Policy between Korea and Japan
	New Instruments and Approaches Including Public-Private Partnerships
	Current Agreements and National View on Enforcement Mechanisms
15:15	BREAK
15:45	Open discussion: Urgent Needs and Future Directions including policy actions, information sharing, early warning mechanisms, research activities, etc.
16:45	Concluding session: Drafting risk governance recommendations and a timeline for related actions
17:45	END OF WORKSHOP