

## International Research (Project No.: 28W-02)

Project name: INTERA-NATECH : **INTER**-Asian initiative on joint **NA**tural and **TECH**nological (Natech) risk reduction at industrial estates

Principal Investigator: Shin-Ichi Aoki

Affiliation: Osaka University

Name of DPRI collaborative researcher: Ana Maria Cruz and Hirokazu Tatano

Research period: April 1, 2016 ~ March 31, 2017

Research location: Osaka University, Kyoto University, Maritime Academy of Asia and the Pacific (MAAP), Bataan, Philippines, and Universidad de los Andes, National Unit for Disaster Risk Management, Ecopetrol, Reficar and others in Colombia.

Number of participants in the collaborative research: 8 ( DPRI staff: 2 , non-DPRI staff: 6 )

- Number of graduate students: 3 ( Master student:1 ; Doctoral student:2 )

- Participation role of graduate students [ Researchers ]

### (1) Purpose:

The main purpose of the study was to propose an international comprehensive area-wide risk management framework for prevention of natural disaster triggered chemical accidents (Natechs) at industrial estates located at earthquake, tsunami and flood prone coastal areas.

### (2) Methodology:

Data for the study included literature review, as well as further development of ongoing methodologies for Natech risk assessment in Osaka and Kyoto universities. Furthermore, the study involved two overseas field trips for data collection through meetings and interviews with stakeholders from government and industrial organizations to elicit expert input for the framework, establish collaborative networks, and explore the possibility of a case study for validation and testing of the framework, as well as testing of hard and soft risk reduction countermeasures.

### (3) Main achievements:

One of the main achievements of the project was the proposal of the first version of the Intera-Natech Risk Management Framework which has served as the basis for the development of a Natech performance rating system.

The key elements of the framework have been identified through an extensive literature review, past research of the Labs involved in the study, and input from two field trips. The first field trip was carried out in Fiscal year 2016, and included a 6-day visit by Prof. Aoki, Cruz and Felipe Munoz-Giraldo (DRS Visiting Professor) to Manila and Bataan in the Philippines to meet with several public and private organizations with the aim of understanding current practices for chemical accident and Natech risk management, raising awareness, establishing a network for Natech risk reduction, and gauging interest and willingness to participate in a case study to validate the proposed framework. Our visit was organized and hosted by Dr. Angelica Baylon of MAAP. We visited the Partnerships in Environmental Management for the Seas of East Asia (PEMSEA), an intergovernmental organization operating in East Asia, to foster & sustain healthy & resilient oceans, coasts, communities & economies across the region. PEMSEA provided contacts at the Industrial Estates in Cavite and Batangas. Furthermore, we held a half-day workshop on Natechs with the Provincial Heads on Behalf of Gov. Abet Garcia in Capitol Hall, Balanga Bataan, who expressed great interest in the work we were doing, but also said that communication with industrial operators/ managers was not generally not good. Meetings with the private sector included attendance to the monthly meeting of the Bataan Coastal Care Foundation for chemical accident prevention, and a visit to the oil terminal of Total.

Visits also included a tour of MAAP's training facilities such as ship navigation simulators, fire-fighting training facilities, LNG tanker navigation and emergency simulators, and so on.

During the field trip to Bataan, we identified important gaps in chemical and Natech risk management in the Philippines, which represented a common problem in Indonesia and other countries in the region. One of the key issues encountered in Philippines, and that has also been a problem in Japan, was that industry was not willing to share much information with us, or with local government officials and other stakeholders. Prof. Munoz-Giraldo, who participated in the field trip to Philippines, said he had close ties with industry in Colombia and could help facilitate industrial visits that would allow the research team to learn from their experience which has involved successfully bringing together diverse stakeholders including government, industry, and academia.

Thus, a second field trip was carried out in FY 2017, this time to Colombia with the participation from Japanese and Indonesian researchers. Prof. Aoki, Cruz, and Munoz-Giraldo were joined by Prof. Syamsidik from the Tsunami and Disaster Mitigation Research Center (TDMRC), Syiah Kuala University in Indonesia. The field visits included eight multi-stakeholder meetings held in the cities of Bogota, Medellin and Cartagena, with the participation of more than 80 experts from more than 20 public and private organizations. The current situation of Natech risk management in Colombia was discussed openly and frankly providing the opportunity to corroborate key aspects needed to be considered in the proposed framework. This input constitutes another important achievement of the project. At the end, we obtained important expert feedback concerning the proposed framework, assessed stakeholder needs and confirmed the possibility of developing a case study in Colombia to validate the framework.

#### (4) Publications and communication of results

Regarding publications and communication of results, important achievements of the project included the organization of an International Workshop on Tools for Natech Risk Management, and the 3<sup>rd</sup> Natech Symposium held at DPRI and Osaka University on 13 and 14 March, 2017, respectively. Invited speakers included Dr. Baylon from the Philippines and Prof. Sandhya Babel from Thailand. Other Natech experts invited included Dr. Matsuoka JGC Corporation in Japan, who gave a presentation concerning damages and losses suffered by LNG terminals in the affected areas following the Great East Japan Earthquake and tsunami in 2011; and Prof. Valerio Cozzani, a Natech expert in probabilistic risk assessment from University of Bologna, Italy.

Furthermore, during Fiscal year 2017 preliminary results of the study were presented at the IDRiM Conference in Iceland, the China-Japan forum in Beijing, and a research meeting at IIASA, Austria. On the other hand, results and findings of the visits in Colombia were presented at the meeting held by the Osaka University Petroleum Complex Disaster Prevention Research Initiative and Members of the Petrochemical Complex Disaster Prevention Technology Research Group. Furthermore, a paper entitled "Stakeholder Input for a Common, Global, Comprehensive Risk Management Framework for Industrial Parks to Manage Risks from Natural Hazards" will be published in the DPRI Annuals Report No. 61. Finally, a manuscript based on this work is under preparation and will be submitted to an international journal.