

## IPL Project (IPL - 175) Annual Report Form 2017

1 January 2017 to 31 December 2017

1. Project Number (approved year) and Title: IPL-175 (2012) Development of landslide risk assessment technology and education in Vietnam and other areas in the Greater Mekong Sub-region
2. Main Project Fields
  - (1) Technology Development
    - A. Monitoring and Early Warning, B. Hazard Mapping, Vulnerability and Risk Assessment
  - (2) Capacity Building
    - A) Enhancing Human and Institutional Capacities
    - B) Collating and Disseminating Information/Knowledge
  - (3) Mitigation, Preparedness and Recovery Preparedness, B. Mitigation, C. Recovery
3. Name of Project leader:

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Core members of the Project:

Japan side: **Khang Dang** (International Consortium on Landslides (ICL) / VNU Science), **Hirotaoka Ochiai** (Japan Landslide Society), **Toyohiko Miyagi** (Tohoku Gakuin University)

Vietnam side: **Dinh Van Tien** <dvtien.gbn@gmail.com>, **Lam Huu Quang** <lhqlinh@yahoo.com>
4. Objectives: The objective is to contribute to landslide disaster reduction along main transport arteries and on residential areas through study on effective application of new technology on forecast, monitoring and treatment of landslides in Vietnam and other areas in the Greater Mekong Sub-region in close cooperation with Japanese universities and also ICL. The following targets are expected: a) Development of Landslide risk assessment technology suitable for the targeted areas in Vietnam. b) Capacity Development for research on landslide risk identification and hazard mapping. c) Social application over the regions.
5. Study Area: Viet Nam, Japan, Countries in the Greater Mekong Sub-region (e.g. Laos and

Myanmar)

6. Project Duration: 8 years, from March 2012 to March 2020

## 7. Report

1) Progress in the project:

Three groups of this project, mapping, testing and monitoring investigated landslides in Vietnam.

- Mapping group (G1) developed landslide distribution maps for Hai Van area, along Ho Chi Minh Route, Route No. 6 and Route No.7. In preparation for the mapping, aerial photographs and topographic maps were purchased and interpreted. Field visits to clarify the landslide phenomena were conducted for Ho Chi Minh route and Hai Van Station area. UAV was used to obtain aerial photography. Also, ALOS W3D data was purchased for landslide topography mapping. For more precise risk analysis and evaluation, fuzzy inference method and AHP approach were used for landslide type classification and landslide susceptibility mapping.
- Testing group (G2) developed a high-stress undrained ring shear apparatus (up to 3 MPa) and applied it in Japan (Unzen Mayuyama) and in Vietnam (Hai van station landslide). A new practical apparatus, specifically designed for Vietnam, was developed and transported to ITST. G2 improved an integrated simulation code (LS-RAPID) to simulate the initiation of landslide due to 10 minutes rainfall records as a trigger. The group developed a new simulation code (LS-Tsunami) to simulate the initiation and motion of landslide-induced tsunami in 2015. This LS-Tsunami was applied to Japan (1792 Mayuyama landslide-induced tsunami) and to Vietnam (Hai van station landslide and its triggering tsunami in Da-nang Bay). The group investigated a rain induced shallow landslide occurred in Ha Long city and killed 8 persons living in three houses in 2015. Ring shear apparatus ICL-1 and computer simulation software LS-RAPID were employed to test and simulate the mechanism of the landslide.
- Monitoring group (G3) completely installed a monitoring system at Hai Van slope with all equipment of 19 extensometers, one total station, 3 static GPS (GNSS), two real time kinematic GPS (GNSS), and one deep geological drillings. Those monitored data are transferred to the ITST in Hanoi. At the ITST Hanoi, landslide flume experiments on soil from Hai Van area, river sand sample, and Ha Long landslide sample were conducted.

The integrated Guidelines including 33 guidelines on landslide mapping, testing, and monitoring were submitted to Vietnam Ministry of Transport and accepted. They will be upgraded to be the basic standards for the management and preservation of highway roads throughout Vietnam. The guidelines, which are the result of collaborative research, were also published in Landslide Dynamics: ISDR-ICL Landslide Interactive Teaching Tools. (Vol.1, Vol.2), a global landslide teaching material for standardization of landslide technology.

9 Vietnam engineers are invited to Japan by this project from 2012 to 2017. They have entered in Kyoto University, Tohoku Gakuin University, Shimane University, and Shizuoka university and studying landslides as master or doctor course students. One student obtained Ph.D in Kyoto University in October 2015; one student took Ph.D in Tohoku Gakuin University in March 2016. One engineer from ITST took his Ph.D. by submitting papers in Tohoku Gakuin University in October 2016. Three engineers recently defended Ph.D (one in Tohoku Gakuin University and two in Kyoto University) and they will obtain the degree in March 2018.

2) Planned future activities or Statement of completion of the Project (15 lines maximum)

Members of the group is now applying a Grants-in-Aid for Scientific Research of Japan Society for the Promotion of Science (JSPS) in Ha Long city, Vietnam focusing on early warning of shallow rapid landslides. The research project title is “WebGIS early warning system of shallow rapid landslides based on rainfall/ground water monitoring, soil testing and hazard assessment for human settlement in developing countries”. The research plan and methods include 3 main steps: data collection, rainfall induced landslide hazard assessment, and early warning system based on rainfall/groundwater monitoring.

3) Beneficiaries of Project for Science, Education and/or Society (15 lines maximum)

Social implementation of the developed landslide risk assessment technology and early warning system is realized to contribute to the safety ensuring of transport arteries and urban and local communities in Vietnam. Such social application is also realized when the Integrated Guidelines are adopted as basic standards and utilized for conducting landslide risk assessment. Vietnamese Landslide Association for Transport (VLAT) was established with more than 120 reaseachers and engineers from institutes, universities, and companies relating to landslide management (survey, design and construction).

Capacity of Vietnamese researchers is strengthened with the long-term and short-term training conducted in the project. A team of young engineers in the research institutes, universities and in technical management agencies in local conditions better awareness in order to prevent landslides as housing, farming and irrigation in mountainous conditions and applying appropriate technology to actively prevent mitigate consequences natural disasters caused by landslides. Results can be disseminated to other developing countries in the region and the world to study and apply.

4) Results: (15 line maximum, e.g. publications)

Doan Huy Loi, Lam Huu Quang, Kyoji Sassa, Kaoru Takara, Khang Dang, Nguyen Kim Thanh, Pham Van Tien (2017) The 28 July 2015 rapid landslide at Ha Long City, Quang Ninh, Vietnam. Landslides Vol. 14 (3), pp 1207–1215.

Lam Huu Quang, Doan Huy Loi, Kyoji Sassa, Kaoru Takara, Hirotaka Ochiai, Khang Dang, Shinro

Abe, Shiho Asano, Do Ngoc Ha (2017) Susceptibility assessment of the precursor stage of a landslide threatening Haivan Railway Station, Vietnam. *Landslides* Vol. 15 (2), pp 309-325.

Dinh Van Tien, Nguyen Xuan Khang, Kyoji Sassa, Toyohiko Miyagi, Hirotaka Ochiai, Huynh Dang Vinh, Lam Huu Quang, Khang Dang, Shiho Asano (2017) Results of a Technical Cooperation Project to Develop Landslide Risk Assessment Technology along Transport Arteries in Vietnam (IPL-175). *Advancing Culture of Living with Landslides* (Sassa K., Mikoš M., Yin Y., eds), Vol.1, pp 411-417. [https://doi.org/10.1007/978-3-319-59469-9\\_36](https://doi.org/10.1007/978-3-319-59469-9_36)

Pham VT, Sassa K, Takara K, Dang K, Le HL, Nguyen DH (2017) Simulating the Formation Process of the Akatani Landslide Dam Induced by Rainfall in Kii Peninsula, Japan. *Advancing Culture of Living with Landslides* (Mikoš M., Vilímek V., Yin Y., Sassa K., eds), Vol.5, pp 497-506. [https://doi.org/10.1007/978-3-319-53483-1\\_59](https://doi.org/10.1007/978-3-319-53483-1_59)

Sassa K, Guzzetti F, Yamagishi H, Arbanas Z, Casagli N, Tiwari B, Liu KF, Strom A, McSaveney M, McSaveney E, Dang K, Setiawan H (2017) Landslide Dynamics: ISDR-ICL Landslide Interactive Teaching Tools (LITT). *Advancing Culture of Living with Landslides* (Sassa K, Mikos M, Yin Y, eds), Vol.1, pp 193-218. [https://doi.org/10.1007/978-3-319-59469-9\\_17](https://doi.org/10.1007/978-3-319-59469-9_17)

Dang K, Sassa K (2018) Simulation of landslide induced tsunami (LS-Tsunami) based on the landslide motion predicted by LS-RAPID. *Landslide Dynamics: ISDR-ICL Landslide Interactive Teaching Tools*. Springer, Vol.2 Testing, Risk Management and Country Practice (to be published in February 2018)

Dang K, Sassa K, He B, Takara K, Inoue K, Nagai O (2018) Undrained dynamic-loading ring-shear apparatus and its application to landslide dynamics. *Landslide Dynamics: ISDR-ICL Landslide Interactive Teaching Tools*. Springer, Vol.2 Testing, Risk Management and Country Practice (to be published in February 2018)

Doan HL, Sassa K, Fukuoka H, Sato Y, Takara K, Setiawan H, Pham T, Dang K (2018) Initiation Mechanism of Rapid and Long Runout Landslide and Simulation of Hiroshima Landslide Disasters using the Integrated Simulation Model (LS-RAPID). *Landslide Dynamics: ISDR-ICL Landslide Interactive Teaching Tools*. Springer, Vol.2 Testing, Risk Management and Country Practice (to be published in February 2018)

Eisaku Hamasaki, Toyohiko Miyagi (2018) Landslide Mapping Through the Interpretation of Aerial Photographs and Topographic Maps. *Landslide Dynamics: ISDR-ICL Landslide Interactive Teaching Tools*. Springer, Vol.1, pp 53-66. [https://doi.org/10.1007/978-3-319-57774-6\\_3](https://doi.org/10.1007/978-3-319-57774-6_3)

Eisaku Hamasaki, Toyohiko Miyagi (2018) Risk Evaluation Using the Analytic Hierarchy Process (AHP)—Introduction to the Process Concept. *Landslide Dynamics: ISDR-ICL Landslide Interactive Teaching Tools*. Springer, Vol.2 Testing, Risk Management and Country Practice (to be published in February 2018)

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Pham Van Tien, Kyoji Sassa (2018) Dynamic Properties of Earthquake-Induced Large-Scale Rapid Landslides Within Past Landslide Masses. *Landslide Dynamics: ISDR-ICL Landslide Interactive Teaching Tools*. Springer, Vol.2 Testing, Risk Management and Country Practice (to be published in February 2018)

Pham VT, Sassa K, Dang K (2018) An integrated model simulating the initiation and motion of earthquake and rain induced rapid landslides and its application to the 2006 Leyte landslide. *Landslide Dynamics: ISDR-ICL Landslide interactive Teaching Tools*. Springer, Vol.2 Testing, Risk Management and Country Practice (to be published in February 2018)

Pham VT, Sassa K, Takara K, Fukuoka H, Dang K, Shibasaki T, Setiawan H, Nguyen DH (2018) Mechanism of large-scale deep-seated landslides induced by rainfall in gravitationally deformed slopes: A case study of the Kuridaira landslide in Kii Peninsula. *Landslide Dynamics: ISDR-ICL Landslide Interactive Teaching Tools*. Springer, Vol.2 Testing, Risk Management and Country Practice (to be published in February 2018)

Sassa K, Dang K (2018) Landslide Dynamics for risk assessment. *Landslide Dynamics: ISDR-ICL Landslide Interactive Teaching Tools*. Springer, Vol.2 Testing, Risk Management and Country Practice (to be published in February 2018)

Sassa K, Setiawan H, He B, Gradiški K, Dang K (2018) Manual for the LS-RAPID software. *Landslide Dynamics: ISDR-ICL Landslide Interactive Teaching Tools*. Springer, Vol.2 Testing, Risk Management and Country Practice (to be published in February 2018)

Setiawan H, Sassa K, Dang K, Ostric M, Takara K, Vivoda M (2018) Manual for undrained dynamic-loading ring shear apparatus. *Landslide Dynamics: ISDR-ICL Landslide interactive Teaching Tools*. Springer, Vol.2 Testing, Risk Management and Country Practice (to be published in February 2018)

Shiho Asano, Hirotaka Ochiai and Huynh Dang Vinh (2018) Landslide Monitoring for Early Warning in the Hai Van Station Landslide in Vietnam. *Landslide Dynamics: ISDR-ICL Landslide Interactive Teaching Tools*. Springer, Vol.2 Testing, Risk Management and Country Practice (to be published in February 2018)

Shinro Abe, Norio Sato, Dinh Van Tien, Do Ngoc Ha, Le Ngoc An, Luu Xuan Khoat (2018) Rotary Sampling Drilling Technology to Extract High-Quality Cores Using a Sleeve-Incorporating Core Barrel and Polymer Mud in Landslide Areas of Japan and Vietnam. *Landslide Dynamics: ISDR-ICL Landslide Interactive Teaching Tools*. Springer, Vol.2 Testing, Risk Management and Country Practice (to be published in February 2018)

Toyohiko Miyagi (2018) Landslide Mapping Through the Interpretation of Aerial Photographs.

Landslide Dynamics: ISDR-ICL Landslide Interactive Teaching Tools. Springer, Vol.1, pp 41-51.  
[https://doi.org/10.1007/978-3-319-57774-6\\_2](https://doi.org/10.1007/978-3-319-57774-6_2)