

# Risk intelligence of structural systems: concepts and recent developments

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## Abstract

To ensure and maintain reliability of civil infrastructures against rapid urbanization, globalization, population growth, and climate change, the concept of risk intelligence is needed. Four elements – identification, integration, inference, and implementation – are proposed and discussed from the viewpoint of data-information-knowledge flow. Recent research developments are presented to provide examples and identify topics of further research toward risk intelligence.

**Keywords:** risk intelligence; machine learning; big data; risk identification; risk integration; risk inference; risk implementation.

## 1 Introduction

Civil infrastructures become more complex and vulnerable to natural or man-made hazards due to rapid urbanization, globalization, and population growth around the world. In addition, climate change gives rise to various risks in societies and may hamper planning a proper risk mitigation strategy. Under this situation, the conventional risk management framework, which focuses on preventing the failures of individual structural members based on uncertainty and risk analysis, has revealed its fundamental limitations.

On the other hand, the rapid developments of information technologies including sensors, communications, and databases enable us to handle large amount of data regarding structural systems and hazards. Equipped with powerful machine learning algorithms and computing capabilities, engineers are now able to build artificial intelligence tools to support various decision-making processes based on real or simulated data.

In this presentation, the concept of *risk intelligence*

is proposed in terms of four elements. After delineating the four elements from the viewpoint of data-information-knowledge flow, some of the recent research efforts are presented as examples.

## 2 Risk intelligence

As artificial intelligence simulates the functions of the human brain in a variety of application areas, the proposed concept of risk intelligence aims to mimic risk-related functions of the human brain. As illustrated in Figure 1, risk intelligence aims to perform Identification, Integration, Inference, and Implementation by applying probabilistic theories

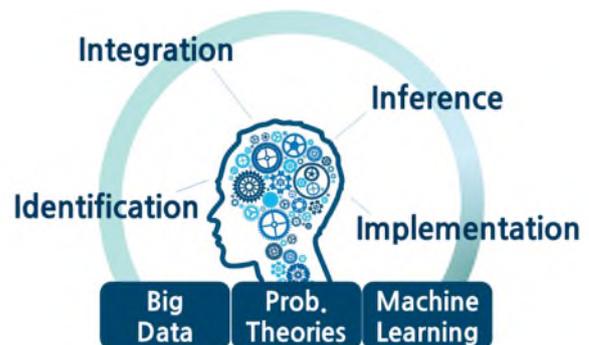


Figure 1. Four elements of risk intelligence