PERCEPTION AND COMMUNICATION OF SEIEMIC RISK

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This paper puts forward a risk communication tool for incentivizing the society to take seismic risk mitigation measures. The tool comprises a web-based system for evaluation and communication of the seismic risk to the society. In effect, the proposed system raises the public awareness of the devastating consequences of earthquakes. The system receives preliminary, observable information of a building from the user, conducts a rapid seismic risk analysis, stores the building information and analysis results in a database, and finally, presents and interprets the risk estimates to the user. The primary usership of the system consists of the owners, stakeholders, or residents of buildings. The system employs the notion of risk perception to put the results of sophisticated earthquake engineering risk analyses into perspective for the user. The system also treats the epistemic uncertainty in the user input due to general public's lack of technical knowledge through the notion of entropy in information theory. Since losses and death toll are familiar concepts to the public, the proposed system defines risk as the expected monetary and social losses, i.e. costs and casualties, respectively, and communicates them with measures that are perceivable to the public. As the medium of this communication, the worldwide web is selected because of its omnipresence and ease of access for the public.

The proposed system is implemented on web at *cira.civil.sharif.edu*. It is hereafter referred to as CIRA, which stands for Civil Infrastructure Risk Analysis. Figure 1 displays the user interface of CIRA that receives the building information

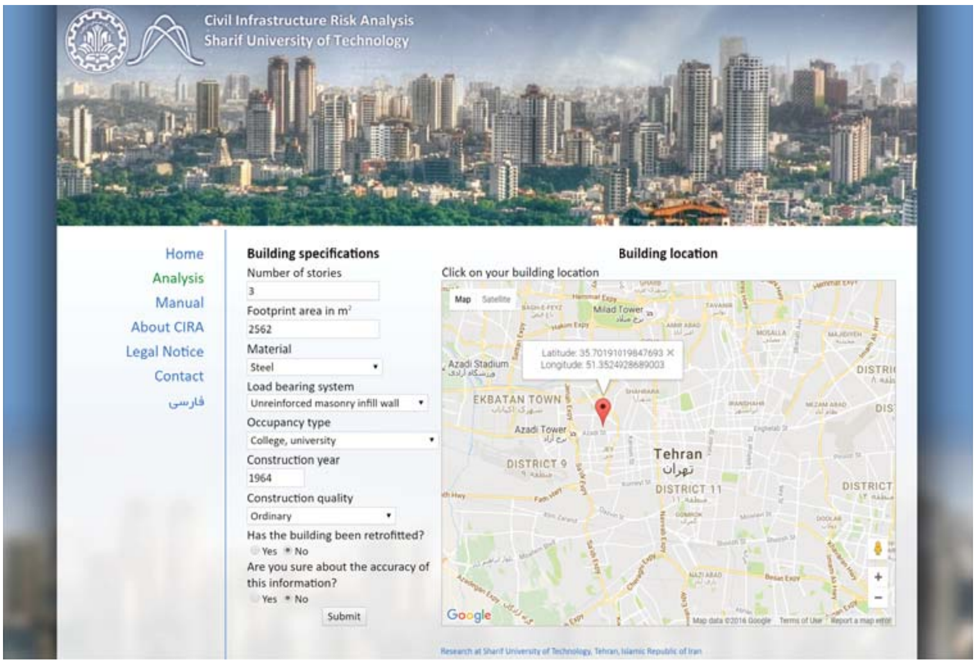

Figure 1. CIRA user interface. The map is © 2016 Google.

from the user. This page asks the user about the preliminary information about the building. In particular, the user inputs the number of stories, footprint area, material, load bearing system, occupancy type, construction year, construction quality, and whether or not the building is retrofitted. The user also specifies the location of the building by clicking on Google Maps®. CIRA employs a prevalent loss estimation methodology (FEMA–NIBS 2012), where modifications are applied to make it applicable to the conventional construction in Iran. In this system, it is acknowledged that a non-technical user is likely unaware or uncertain of the material and load bearing system of the building. Hence, the system allows the user to express that uncertainty by providing such options as “I don’t know” or “Either steel or concrete.” Upon selecting these options, the system will proceed to using the notion of entropy (Shannon, 2011) to compute an expectation of the results using all possible outcomes, as elaborated later. As the final entry, the user chooses whether she or he feels that the information is accurate. If so, the system commences a data validation process by the notion of cross-validation (Kohavi, 1995) to ensure the accuracy of the data for the purpose of storing the provided information and the ensuing risk estimates in the database.

This paper concluded with a case study section that presents a successful application of CIRA. In this application, the CIRA tool was employed to communicate the seismic risk to decision makers in charge of the building portfolio at the campus of Sharif University of Technology (SUT). SUT was established in 1966. While the campus has undergone a rapid expansion over the last decade, many of its buildings were constructed in 1960s, an era before the emergence of the seismic design code in Iran. These buildings are a major source of seismic risk, yet a comprehensive retrofit plan has not been a priority for resource allocation compared to the likes of equipping the laboratories and establishing new departments and research centers. In addition to budgetary limitations, a lack of perception of the vast potential for seismic monetary and social losses in campus has always contributed to this absence of attention. CIRA produces a regional representation of the seismic risk to put the risk estimates of individual buildings into perspective for the campus management. This regional view provides a decision support tool by identifying the buildings with the highest risk, which is crucial in communicating the risk to decision makers. This application of CIRA incentivizes the campus management to develop a seismic retrofit plan and guides the allocation of resources to buildings with the highest levels of social and monetary losses.

REFERENCES

FEMA-NIBS (2012). Multi-hazard loss estimation methodology-earthquake model-HAZUS-MH MR4 technical manual. *Federal Emergency Management Agency and National Institute of Building Sciences*, Washington, DC.

Kohavi, R. (1995). A study of cross-validation and bootstrap for accuracy estimation and model selection. *Proc. Int. Joint Conf. on Artificial Intelligence. 14*(2), 1137-1, Montreal, Canada.

Shannon, C.E. (2011). A mathematical theory of communication. *ACM SIGMOBILE Mobile Computing and Communications Review, 5*(1), 3-55 [Reprint].