論文審査の要旨及び担当者

報告番号	甲 乙 第　　　　　　号	氏　名	櫻井　美穂子
論文審査担当者	主　査　政策・メディア研究科委員 兼 総合政策学部教授　國領　二郎		
	副　査　政策・メディア研究科委員 兼 環境情報学部教授　加藤　文俊		
	副　査　政策・メディア研究会委員 兼 総合政策学部教授　飯盛　義徳		
	副　査　慶應義塾大学大学院メディアデザイン研究科教授　大川　恵子		
	副　査　The University of Georgia Regents Professor and the J. Rex Fuqua Distinguished Chair for Internet Strategy　Richard T. Watson		
学力確認担当者：			

（論文審査の要旨）

Mihoko Sakurai's doctoral thesis is entitled "Design of a Resilient Information System for Disaster Response: Lessons from municipal government systems under the Great East Japan Earthquake crisis," and contains eight chapters in two parts. Part one records and analyzes the learnings from the calamity. Part two proposes a set of design principles based on the learnings to prepare for the future. Validities of the design principles are evaluated through questionnaire surveys, technical reviews and a field test.

Part one starts with chapter one that describes the state and roles of municipal government information systems in disaster situations. It describes how the systems failed in the Great East Japan Earthquake in spite of their importance in saving lives in extreme conditions. It stresses the importance of having a disaster management strategy for information systems and explains how the thesis discusses the problem.

Chapter two explains the "design science approach" that this thesis adopts. It is essentially a declaration that this paper will go beyond the analyses of the experience, but will step into the task of setting design principle to build future systems. The approach consists of determining the requirements, coming up with solution proposals, and evaluating the proposal by various means.

Chapter three explains the results of structured interview of 13 most seriously damaged municipal governments in Iwate, Miyagi and Fukushima that were conducted eight months to ten months after the earthquake. Among many other things, it reports that while prevention of structural damage to the buildings that housed information systems (which was the focal point of the preparation against earthquakes) was quite successful, information systems were nevertheless crippled with other causes. The causes included prolonged power outages and water intrusions that were not anticipated. The chapter also reports that the diversity of situations both by location and time, severely limited the usefulness of national disaster victims support system that was developed based on the experiences of 1995 Hanshin Awaji Earthquake. As a result, developments of temporary systems were observed in all of the locations interviewed. A separate case study of how Tagajo City developed their system is provided to deepen the understanding of how such "creative responses" happened. The chapter also reports how these creative but uncoordinated responses led to loss of interoperability in the subsequent phase. Based on these findings, the chapter identified three "Key IS Problems," i.e., (1) unexpected ICT failure, (2) crisis diversity and complexity, and (3) lack of compatibility that need to be addressed in the design of future systems.

Chapter four attempts at providing solid theoretical backgrounds, based on literature review and the findings from the field research, to the design principles to be discussed in part two. Notions of (a) preparedness, (b) resilience, (c) creative response are studied. A particular emphasis was placed on the understanding of resilience. Distinction between the notion of returning to normal operations and the

notion of adapting to emergent situations is strongly emphasized. The author subsequently declares that "resilience in this research is defined as quickly gaining essential capabilities to perform critical post disaster missions and to smoothly return to fully stable operation thereafter," and moves on to part two that discuss design principles that realize resilience.

Part two, entitled "Solution Design for the Future " starts with chapter five that discusses requirements for solutions. The chapter first introduces a three staged model, based on the recognition that situations in disaster situations changes temporally. Three stages are: in advance, initial response and recovery stages. The chapter then introduces the concept of "frugal IS," as advocated by Richard T. Watson. Watson defines frugal IS as, "an information system that is developed and deployed with minimal resources to meet the preeminent goal of the client." He also advocates the usefulness of "four u-constructs," i.e., (1) universality, (2) ubiquity, (3) uniqueness, (4) unison, in realizing frugal IS. Sakurai moves on to adapt the frugal IS notion in designing a resilient information system.

Chapter six discusses how the three stage model and the frugal IS concepts can be applied to develop a set of design principles of IS that realize resilience in future disaster situations. One primary assertion is the change of the design goal from delivery of uninterrupted service by robust (unbreakable) system, to adaptive service by frugal IS that allow creative response. The notion of bricolage is introduced to explain. While advocating the value of creative responses, Sakurai also warns that uncoordinated creative responses may lead to fragmentation of data that hinder communities to return to normal operations in the recovery stage. She asserts the importance of maintenance of uniqueness and unison of data, that are central notions of frugal IS, should be incorporated during the initial response stage. This means standardization of data formats among autonomous and creative efforts in the initial response stage. This can only be achieved by training people in the "in advance" stage.

Chapter seven evaluates the generalizability of the design principle proposed in chapter six. Based on feedbacks the author received in the publications of internationally recognized refereed journals, several key variables that may affect the usefulness of the design principles are identified. The variables considered were (1) whether frugal IS notion can be applied in all aspects of IS including infrastructure such as telecommunication, (2) whether the notion of frugal IS is effective in all kinds of disasters, and (3) practicality of using tools such as smartphones in critical missions. On paper technical simulations, questionnaire surveys and field drill to test the practicality of "BYOD (bring your own device)" were conducted in Tome City to evaluate the frugality concept. As a result of the evaluation, the chapter admits that frugal IS may be limited in usefulness in such areas as, telecommunication access to outside of disaster areas, and certain types of disasters such as heavy rain fall. Recognizing these limitations, Sakurai advocates a hybrid approach combining the benefits of robust and frugal systems.

The final chapter, chapter eight, discusses the contributions of this paper. At the theoretical level, the paper is original in demonstrating how frugal design may increase the resilience of systems by allowing creative and adaptive solutions to function. The paper is also new in the sense that it incorporated organizational capability in addition to the mechanical design of IS to increase the resilience. At the practice level, the paper is significant in asserting that creative responses, as opposed to a well-planned responses, should be given a role in the preparation against great disasters.

In addition to the eight chapters, the thesis provides rich account of the Great East Japan Earthquake in the appendices. Appendices also include questionnaire formats used in the research, as well as teaching material developed in the process of the research.

All of the members of the thesis review committee agree that the thesis is of great value. First and foremost, it turned the most tragic experience of the Great East Japan Earthquake into valuable lessons that is likely to save many lives in the future. The theories developed goes beyond simply explaining what happened but provide important design philosophies for future information systems.

It should also be noted that Sakurai made a great effort to share the learnings with the world by publishing the works in the international domains. The works were highly valued by organizations such as Harvard University Berkman Center for Internet and Society, who were quick to publish the early result of field survey in the form of a working paper. ITU also recognized the work by awarding an interim paper the best paper award in the 2013 Kaleidoscope academic conference.

The thesis naturally has limitations. Most notable is the limits in the generalizability of the result. While applicability of the frugal design concept is evaluated from multiple perspectives, the original idea came from a single case. Testing of the framework in other disaster situation is desired.

In spite of such limitations, this committee strongly believes that Sakurai demonstrated her ability to conduct solid research independently by producing valuable outcome. We conclude that Mihoko Sakurai should be awarded a Ph. D in Media and Governance.