Faculty of Engineering and Information Technology

Agent-Based Modelling for Disaster Management Knowledge Analysis Framework

Dedi Iskandar Inan

A thesis submitted in fulfilment of the requirement for the Degree of Doctor of Philosophy

University of Technology Sydney

November 2017

Certificate of Original Authorship

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as part of the collaborative doctoral degree and/or fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

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Dedi Iskandar Inan

Acknowledgement

I have indebted a gratitude to my principle supervisor, Professor Ghassan Beydoun, for his assistance during my difficult times. His mentorship and encouraging comments has improved my research and writing skills. All these experiences have been assisting me to materialise this thesis and would have been the privileges for my awaiting career ahead.

I also would like to express my sincerely gratitude to Simon Opper and Andrew Sheehan who are the DM experts from State Emergency Service of the New South Wales and the Victoria States, respectively. They have been giving invaluable feedbacks for a better construction of this dissertation, particularly in the evaluation stages. It was such as pleasure and honour collaborating with them. Looking forward to collaborate with them again in the future. I would also thank Dr. Jay Daniel, for reading and giving generous editing feedback on the late drafts of the early chapters (in particular chapters 1 and 2).

Indonesia government through Directorate General Higher Education and the Graduate Research School of the University of Technology Sydney deserve much appreciation for their generous financial assistances during my life in Australia. Through their commitments, I could complete what I had started in pursuing my PhD degree.

My number one fan of all time, my mother, who is and has always been put me in her perpetual *do'a*. I am nothing without her. She always gives the best to her children. My late father, who passed away years ago, I have nothing to say except *do'a*. I could not be more grateful as you both have enabled and supported us, all your children, pursuing higher educations. May you will always be poured with *His rahmah*. Sary and Ira, and Akbar who always support me, thank you for being my sisters and brother, no matter what!!

My life here would not have been exciting without so many jokes and joy from my Indonesia fellows, particularly, in the PPIA-UOW, the JPI, the WIBG, thank you, folks. I also would like to personally thank to my new other families here: Saiful, Indri, Alim, Khas, Duddy, thank you very much for so much memory and fond we shared together. The GH48 gang, Antares and Hendris, thank you for bringing the real-world atmospheres out of the world research insanity. Thank you for the *jalan-jalan* and the *makan-makan*. You are my brothers, whatsoever. I would also thank to Paulsgrove 19, a place that will always be part of my reminiscent and memories that

I have spent years living at since I kicked off my PhD journey, and all the tenants I shared with: Ali and Amanda, Suhael, Jolin, Nadeera, Michael and Abdullah, thanks folks!! For the house's commander, Dawn, thank you very much for your kindness. Thank you for being a camaraderie with me.

Finally, to my three princesses, Ratna, Kayla and Kanaya, I have nothing to say but thank you very much from my deepest heart. I could not be more grateful to have you in my life. Thank you for being inseparable for me. Being far away from you during my journey does not only teach me how priceless you are but also shows me the true value of a family is. For you, this PhD dissertation is dedicated for. For Kayla and Kanaya, one day when you are able to comprehend this thesis, you are nothing but my joy and happiness. *Insha Allah* this dissertation paves a way for you to achieve more in your future endeavours. To my wife, Ratna, who is and will always be understanding me, thank you for tolerating me from being away from home, from raising our children and from being a good father and husband. Thank you for your love and patient. For you, I owe my deepest gratitude.

Abstract

In Disaster Management (DM), reusing knowledge from best practice and past experience is envisaged as the best approach for dealing with disasters. It is important to recognise however that there are no identical disasters. But there are obvious similarities. The challenge is to identify the similarities in the diverse complex characteristics inherently intertwined in the DM knowledge. There are often various autonomous entities: individuals, agencies, organisations, involved in the DM that are coming with their interests, hierarchy structures, resources, and etc., that need to be interacted and communicated with in DM. They have to deal with uncertainty and time-sensitivity as the critical factors otherwise any single situation might lead to the catastrophic.

An authoritative agency typically leads the combat of a disaster. The agency organises and elicits the knowledge subsequently structure it into a sharable and reusable format, the Disaster Management Plan (DISPLAN). DISPLANs are maintained by the authoritative agencies encompassing the Prevention, Preparedness, Response and Recovery (PPRR) phases. In a case of disaster, the DISPLAN will be activated to be accessed by the stakeholders. However, accessing the knowledge out of the DISPLAN is challenging. Knowledge in DISPLANs tends to be structured in a business specification format. Accessing the knowledge can have a subjective element. The fuzziness and the intertwine of knowledge across all PPRR phases in their structure can hinder access in a timely manner.

This dissertation contributes to development of a knowledge transfer analysis framework to unify access to DISPLANS through a unified repository. This framework is developed following Design Science Research (DSR) methodology in Information System (IS). Agent-Based Models (ABMs) are used to code the DISPLANs to enable their transfer into a repository. ABMs enable the representation of many DM characteristics and processes expressed in the DISPLANs. The Object Management Group (OMG) Metamodeling Framework is then used to create a repository that is ready for storing the content of ABMs. The repository itself is underpinned by a metamodel structure that facilitates the retrieval and DM decision making processes in the context of their use. The overall approach is evaluated using DISPLANs from the State Emergency Services (SES) in Australia. The framework is successfully used to analyse and convert the SES DISPLANs into the metamodel based repository. The resultant approach and repository enable better access, sharing and maintenance of the DM knowledge.

Publications

A number of publications as the outcome being produced from this thesis are in peer-reveiwed of an internatioan journal and conferences and a poster presentation.

Conference

- Inan, D. I., Beydoun, G., & Opper, S. (2015). *Towards knowledge sharing in disaster management: An agent oriented knowledge analysis framework*. Paper presented at the Proceedings of the 26th Australasian Conference on Information Systems (ACIS2015), Adelaide, South Australia, and 30th November - 4th December 2015 (ABDC/ACPHIS "A").

- Inan, D. I., Beydoun, G., & Opper, S. (2016). *Customising Agent Based Analysis Towards Analysis of Disaster* Management *Knowledge*. Paper presented at the Proceedings of the 27th Australasian Conference on Information Systems (ACIS2016), Wollongong NSW Australia, 5th-7th December 2016 (ABDC/ACPHIS "A").

- Inan, D. I., & Beydoun, G. (2017). *Facilitating Disaster Knowledge Management with Agent-Based Modelling*. Paper presented at the Proceedings of the 21th Pacific Asia Conference on Information Systems (PACIS2017), Langkawi Malaysia, 16-20 July, 2017 (ABDC/ACPHIS "A").

- Inan, D. I., & Beydoun, G. (2017). Disaster Knowledge Management Analysis Framework Utilizing Agent-Based Models: Design Science Research Approach. Paper presented at the The 4th Information Systems International Conference (ISICO 2017) Bali Indonesia, 6-8 November 2017.

Journal

- Inan, D. I., Beydoun, G., & Opper, S. (2017). *Agent-based knowledge analysis framework in Disaster Management*, Special Issue on Disaster Management and Information Systems: insights for emerging challenges*, Information Systems Frontiers*, pp. 1-20 *(Forthcoming)* (ABDC/ACPHIS "A").

Award

- Inan, D. I., Beydoun, G., 2015, *Agent-Oriented Analysis as an Intermediate Framework for Disaster Management Knowledge Sharing*, The third winner of poster presentation, School of Computing and Information Technology (SCIT) tradeshow and Research Showcase, University of Wollongong, 29 October 2015.

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