SUPPORTING THE COMPLEXITY OF MANAGING INFORMATION TECHNOLOGY PROJECTS: APPLICATION OF LIVING SYSTEMS THEORY

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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 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.

Signature of Student:

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PUBLICATIONS

Shiva Mir, Igor Hawryszkiewycz, Didar Zowghi,"A Method to Explore Wicked Problems in Complex Environments: A Research Proposal" , International Business Information Management Association (IBIMA), Barcelona, Spain, 2012, ISBN/ISSN: 978-0-9821489-8-3, pp. 1951-1955.

Shiva Mir, Igor Hawryszkiewycz, Didar Zowghi, "Toward a Methodology for Managing Complexity in Information Systems Development Projects", International Business Information Management Association (IBIMA); Barcelona, Spain, 2012, ISBN/ISSN: 978-0-9821489-8-3, pp. 1938-1943.

Shiva Mir, Igor Hawryszkiewycz, "Manufacturing Processes As System Of Systems: Functional And Behavioural Perspectives", IADIS International Conference on Information Systems, Berlin, Germany, March 2012 in Proceedings of the IADIS International Conference on Information Systems, Berlin, Germany, pp. 377-382.

Shiva Mir, Igor Hawryszkiewycz, Debora Banker and Jinjun Chen 2012, "Disasters as Wicked Problem: An Analytical Approach", IADIS international conference information systems, Berlin, Germany, Berlin, Germany, ISBN/ISSN: 978-972-8939-68-7, pp. 337-340.

Shiva, Mir, Igor Hawryszkiewycz, 2011, "Exploratory modelling for complex systems", ICCEM, International conference on computer engineering and management, Puerto Rico, USA, ISBN/ISSN: 978-0-7918-5985-8.

Shiva, Mir, 2010, "Defining the criteria for supporting pervasiveness in complex adaptive systems", MobiQuitous 2010, 7th UCPA international conference, Sydney, Australia. ISBN/ISSN: 978-963-9995-20-8.

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ABSTRACT

The main objective of this research is motivated by the challenge of IT project failure in terms of cost overrun and time delays which is a common practice and is being investigated for years now. Increasing complexity of projects or an underestimation of the project complexity is one of the reasons for project failure, which is the main focus of this study. For this reason, the present work seeks to understand how to apply living systems theory as new lens to investigate and support the complexity of managing IT projects; where management is about "preparation and facilitation" of the project tasks. To achieve research objectives, this study defined management framework based on interpretation of the literature and elicitation of expert opinions through online questionnaire. This framework provide guidelines for project managers to map and study project management processes to identify important issues that leads project to complexity and failure. It also provides suggestion on how to deal with these issues. Through presentation of the framework and supporting guidelines during semi-structured interview with experts, this research investigates the applicability and appropriateness of the proposed approach. The outcomes of this research help project managers to identify important issues that might arise in the project and assist them on how to facilitate and prepare management processes. Academia's can use the result of the project to develop tools to measure complexity in projects. With this measurement, they will be able to estimate project timelines and costs more precisely.