

Chapter 15

Integrating Conceptual and Empirical Approaches for Software Engineering Research

Annette L. Steenkamp

Lawrence Technological University, USA

Theresa Kraft

University of Michigan-Flint, USA

ABSTRACT

This chapter addresses the systemic integration of conceptual and empirical methods in Software Engineering (SWE) research in terms of the systems approach, where theory, empiricism, and pragmatics are combined as required in the research phases. The following themes form the framework of systemic integration during SWE research processes: Theme 1 - Research Planning (Problem Analysis & Literature Review); Theme 2 – Proposal Development; Theme 3 – Conceptualization; Theme 4 – Experimentation and Research Validation. An illustrative research example is provided in terms of the four themes. The purpose of this research example was to provide a way to uncover potential causes of Information Technology (IT) project failures by employing a systemic and holistic approach to identify critical success factors for Project Management (PM). This has enabled the development of an Information Technology Project Management approach, which provides a method to evaluate the critical success factors of a given project, and the alignment of these factors with each other. The systemic methodology and its implementation proposed in this research increase the potential for IT project success by alerting project leaders of potential problems throughout the life of the project.

INTRODUCTION

Software engineering (SWE) may be defined as the “disciplined application of theories and techniques from computer science to define, develop, deliver,

and maintain, on time and within budget, software products that meet customer’s needs and expectations” (Melhart, 2000). This definition means that the issues of software quality, sound principles of software development, and efficiency of the software development process should be part of

DOI: 10.4018/978-1-4666-0179-6.ch015

the research context, while focusing on a particular topic within the field. An analysis done by De Villiers (2005) found that SWE research has focused in great part on systems/software (55%) and systems/software management (12%). Research has been done within the category of developing information technology (IT) systems, where the goal is to develop practical, innovative ways to solve real problems. Design research, originally espoused by Simon (1981), on the other hand is described as a problem-solving, performance improving approach. This approach in the greater area of IT systems focuses on IT enablement, and involves the creation of innovative IT artifacts and products that explain and motivate their functions (Hevner, March, Park and Ram, 2004).

General research topic categories may be considered, for example the software development process (improving the efficiency), SWE methodologies, SWE technologies, quality assurance, SWE management, management of software complexity, and business and software process integration. Conceptual research in SWE, also known as non-empirical research, is being performed in the areas of conceptual behavioral research and conceptual design research as well as philosophical issues underpinning such research (Pather & Remenyi, 2005) and dichotomies of information systems (IS) research (Brinkkemper & Falkenberg, 1991).

More common are empirical behavioral research and empirical design research. Mora, Gelman, O'Connor, Alvarez & Macia-Luevano (2008) have studied the models and standards adopted in the fields of Systems Engineering, SWE and IT using the theory of systems. Applied research in the field of SWE involves conceptual and empirical analysis and formulation during the development of original and innovative solutions to problems. The authors are promoting the adoption of systems thinking in SWE research as a sound way to understanding and solving complexities of IT enablement in business and industry (Kraft & Steenkamp, 2010).

This chapter addresses the systemic integration of conceptual and empirical methods in SWE research in terms of the systems approach, where theory, empiricism and pragmatics are combined as required in the research phases. The following themes form the framework of systemic integration during SWE research processes: Theme 1 - Research Planning (Problem Analysis & Literature Review); Theme 2 – Proposal Development; Theme 3 – Conceptualization; Theme 4 – Experimentation and Research Validation. The rest of the chapter provides an illustrative research example in terms of the four themes.

The authors describe an approach to SWE research which is grounded in the systems approach, with systemic integration of conceptual and empirical methods adopted in an investigation. The chapter has two parts, namely Part I which describes the conceptual and empirical aspects of the approach to SWE research in terms of four themes. Part II contains an illustration of the approach in a doctoral research project.

Part I. Theoretical Content. The theoretical aspects of an approach to SWE research is presented in terms of the following main themes: Theme 1 - Research Planning (Problem Analysis & Literature Review); Theme 2 – Proposal Development; Theme 3 – Conceptualization; Theme 4 – Experimentation and Research Validation.

Part II. Illustrative Example Content. An actual research project illustrating the application of the approach in terms of the four themes presented in Part I.

PART I. THEORETICAL CONTENT

Following on work by a number of researchers, the systems approach has emphasized the characteristics of a system as: teleological; has a determined performance; has users; has components, each with a purpose; is embedded within an environment; includes a decision-maker; and there is a designer (Churchman, 1979). The designer

20 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:
www.igi-global.com/chapter/integrating-conceptual-empirical-approaches-software/63269

Related Content

An Efficient Intra-Server and Inter-Server Load Balancing Algorithm for Internet Distributed Systems

Sanjaya Kumar Panda, Swati Mishra and Satyabrata Das (2017). *International Journal of Rough Sets and Data Analysis* (pp. 1-18).

www.irma-international.org/article/an-efficient-intra-server-and-inter-server-load-balancing-algorithm-for-internet-distributed-systems/169171

Improvement of K-Means Algorithm for Accelerated Big Data Clustering

Chunqiong Wu, Bingwen Yan, Rongrui Yu, Zhangshu Huang, Baoqin Yu, Yanliang Yu, Na Chen and Xiukao Zhou (2021). *International Journal of Information Technologies and Systems Approach* (pp. 99-119).

www.irma-international.org/article/improvement-of-k-means-algorithm-for-accelerated-big-data-clustering/278713

Collaborative Design: An SSM-enabled Organizational Learning Approach

Anita Mirijamdotter and Mary M. Somerville (2009). *International Journal of Information Technologies and Systems Approach* (pp. 48-69).

www.irma-international.org/article/collaborative-design-ssm-enabled-organizational/2546

Aspects of Various Community Detection Algorithms in Social Network Analysis

Nicole Belinda Dillen and Aruna Chakraborty (2018). *Encyclopedia of Information Science and Technology, Fourth Edition* (pp. 6961-6972).

www.irma-international.org/chapter/aspects-of-various-community-detection-algorithms-in-social-network-analysis/184393

Computer Simulation of Particle Packing In Bituminous Concrete

Kasthurirangan Gopalakrishnan and Naga Shashidhar (2009). *Utilizing Information Technology Systems Across Disciplines: Advancements in the Application of Computer Science* (pp. 243-260).

www.irma-international.org/chapter/computer-simulation-particle-packing-bituminous/30729