

Chapter 8

On IT and SwE Research Methodologies and Paradigms: A Systemic Landscape Review

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ABSTRACT

In this chapter, the authors review the landscape of research methodologies and paradigms available for Information Technology (IT) and Software Engineering (SwE). The aims of the chapter are two-fold: (i) create awareness in current research communities in IT and SwE on the variety of research paradigms and methodologies, and (ii) provide an useful map for guiding new researchers on the selection of an IT or SwE research paradigm and methodology. To achieve this, the chapter reviews the core IT and SwE research methodological literature, and based on the findings, the authors illustrate an updated IT and SwE research framework that comprehensively integrates findings and best practices and provides a coherent systemic (holistic) view of this research landscape.

1. INTRODUCTION

In the context of Information Technology (IT) and Software Engineering (SwE) research a research methodology may be defined as the application

of the modern scientific method (which can or not including empirical experimentation). In turn, the modern scientific method (Ackoff, Gupta & Minas, 1962; Popper, 2002; Checkland, 2000), is a systematic, rational, verifiable/falsifiable process for: (i) answering questions on a natural, artificial or social situation, (ii)a solving the problem (an

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optimized solution) or (ii) b) resolving a problematic well-structured natural, artificial or social situation (a satisfactory solution), or (ii) c) gaining a better understanding of a complex natural, artificial or social situation; and (iii) developing better methods and physical or conceptual instruments for doing (i) and (ii).

Research methods are key conceptual knowledge devices for gaining and applying scientific knowledge. Thus, the final quality of the gained and applied knowledge on a natural, artificial or social situation relies strongly on the adequacy of the research method/s used.

Given that the landscape of available IT and SwE research methodologies has been expanded in the last decade, we believe a holistic summary and synthesis is required. The basic set of 5 to 7 main research methods (Straub, Ang & Evaristo, 1994), including survey, case study, laboratory experiment, conceptual, classic simulation, and engineering methods (Alavi & Carlson, 1992) has been increased by research methods, adopted from other disciplines, such as action research, grounded data theory, historical, ethnography, hybrid simulation, robust design, and mathematical proofs, among others. Furthermore, new research paradigms, defined as a set of philosophical assumptions about the objects of study and their related meta-methods, have emerged from classic positivism, classic interpretative, and classic systemic to modernism, transcendental realism (also known as critical realism), and modern systems approach. Consequently, the expansion of research paradigms and methodologies available for IT and SwE research is providing new opportunities for gaining and applying scientific knowledge. However, as with any set of techniques and tools, the method/s that is/are selected should be used correctly and for the appropriate situations.

In this chapter we review the landscape of research paradigms and methodologies available for IT and SwE from a systemic view. Our aims are two-fold: (i) create awareness in IT and SwE current research communities on the variety of

research paradigms and methodologies, and (ii) provide an useful map for guiding new researchers on the selection of an IT or SwE research paradigm and methodology. To attain these aims, we firstly review the core IT and SwE research methodological literature. Secondly, we report the main findings of the literature review. Thirdly, we illustrate an updated IT and SwE research framework based on the findings. Finally, we report the implications, recommendations and limitations of our study.

2. BACKGROUND ON RESEARCH METHODOLOGIES AND PARADIGMS IN IT AND SWE

We can define a systemic research approach (extended from Ackoff *et al.*, 1962; Checkland, 2000; and Jackson, 1990) as an answering and problem-solving system comprised of the following components: (i) research paradigms (P's: a set of philosophical ontological, epistemological and axiological assumptions on the world); (ii) research purposes (S's: observe a situation (explore, describe or measure, predict, explain), or modify a situation of study (control, intervene or evaluate)); (iii) theoretical frameworks (F's: ideas-constructs, theories, and models); and (iv) research methodologies (M's: methods, techniques, and instruments), used for gaining or applying scientific knowledge; (v) the situational areas (A's: natural, artificial, social or hybrid objects of study) on which the M's are applied.

The first component of a research approach (P's: the research paradigms) accounts for the essential underlying assumptions on the constitution of the domain under study (i.e. ontology), the available modes of access to knowledge based on the set of previous knowledge, valid methods used, and interactions of the researchers with such elements (i.e. epistemology), and the human values pursued or affected by a research process (i.e., axiology) (Mingers, 2003). The second

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