Research Approach in Enterprise Engineering: a matter of engineering

Niek J. Pluijmert[1,2], Wolfgang A. Molnar[3], Hend*erik* A. Proper[1, 3]

[1] Radboud University, Nijmegen, The Netherlands
[2] INQA Quality Consultants, P.O. Box 195, 4130 ED, Vianen, The Netherlands
[3] CRP Henri Tudor, 29, avenue John F. Kennedy, L-1855 Luxembourg – Kirchberg
pluijmert@inqa.nl, email@wolfgang-molnar.com,
erik.proper@tudor.lu

Abstract. Enterprises encounter serious problems in keeping pace with ever faster changing markets. Enterprise Engineering (EE) is an emerging field that is promising in providing solutions. Doing research in this field, requires engineering of the research method. We structure available methods, approaches and techniques for qualitative research in information systems. We describe three epistemologies and discuss the different qualitative research methods and differences and similarities between them. For our research on EE that applies transaction cost economics in designing enterprises using the notions of Enterprise Ontology and Enterprise Architecture we combine a positivist approach during literature study with an interpretivist approach during Action Research.

Keywords: Enterprise Engineering, Research Approach, Qualitative Research Methods, DEMO, Design Science, Action Research.

1 Introduction

Organizations change rapidly because they must keep pace with ever faster changing markets. But organizations have serious problems in controlling changes. In trying to adapt to necessary changes, organizations may perform projects. In international surveys[1] it is found that many strategic (or ICT) projects fail. More in detail it is found that most of the large (labor costs over $ 10 million) projects fail or are challenged, while small (labor costs less than $ 1 million) succeed. The top 3 causes are (lack of) involvement of qualified users, support by management (fast decision making) and clear objectives. Tools and infrastructure are in the 10th place. So, technical factors (tools and infrastructure) are less important than social factors (the top 3 causes) for projects to be successful. Dietz & Hoogervorst [1] investigated to what extend enterprises derive success from their strategy: the majority of the strategic initiatives fail. They distinguish two factors, one is the strategy chosen and

[1] International Standish Group 2010

its adaptation over time and the other is the implementation of the chosen strategy. They argue that research has shown that strategic failure is mostly the avoidable result of inadequate strategy implementation. The impact of ICT on enterprises is increasingly acknowledged to be fundamentally strategic as new ICT penetrates progressively the core business processes [2]. So the integration of ICT in the enterprise is necessary because then the emphasis is put on the social factors and less on technical factors.

An answer to these problems can probably be found with Enterprise Engineering (EE). EE is an emerging field and combines relevant parts of traditional organization sciences and information system sciences. According to Dietz [3] the basic premise of EE is that an enterprise is a designed system and for the design of an enterprise the notions of enterprise ontology and enterprise architecture are crucial. Enterprise Ontology provides a means to make a model of the construction of an enterprises at a high level of abstraction, i.e. completely independent of its implementation. Enterprise Architecture is defined as the set of design principles that an enterprise applies in designing itself. As is known from engineering practice, without these principles the design freedom would be practically unlimited which is of course not desirable. We feel EE is a good candidate to offer solutions for the above mentioned problems enterprises encounter to keep pace with the ever faster changing markets.

Fields like EE require specific research methodologies with which one can devise artifacts and at the same time study how useful they are. The reason for this article is that we want to make clear (for the readers as well as for ourselves) the position that we take towards research in EE and what are accepted ways of doing research in this field. We base ourselves on the work of Myers [4] about qualitative research in IS which is available in an updated version as a website[2].

Our scope is *organizations* and *information systems*. We approach the research from the IS side and we realize we also could have taken an approach from the organization sciences. We take the approach from the IS side because it is about engineering and also because this fits best with our background, that is in IS.

2 Literature Review

First we'll give the definition of Enterprise Engineering we want to use. In accordance with the AppEER- website[3] we define EE as the overarching term for the disciplines (among which are also enterprise architecture and enterprise ontology, see 1 Introduction, and also business process management, enterprise modeling, enterprise transformation) that study the engineering of socio-technical systems. With socio-technical systems we mean specifically information systems (IS) in their full alignment with their human / organizational context. Because EE is an emerging field of research without (yet) commonly accepted research approaches, we investigate in this chapter research approaches for IS research to find an approach for EE.

[2] http://www.qual.auckland.ac.nz/

[3] Appeer.ee-team.eu

There are different ways to structure methods, approaches and techniques that researchers use. In this article we follow Meyers [4] in his description of qualitative research in information systems. We want to study organizational and managerial aspects of IS, hence these are social phenomena, a qualitative approach is the most appropriate according to Meyers. In Figure 1 we schematically give the relation between qualitative research methods and epistemology that we will explain.

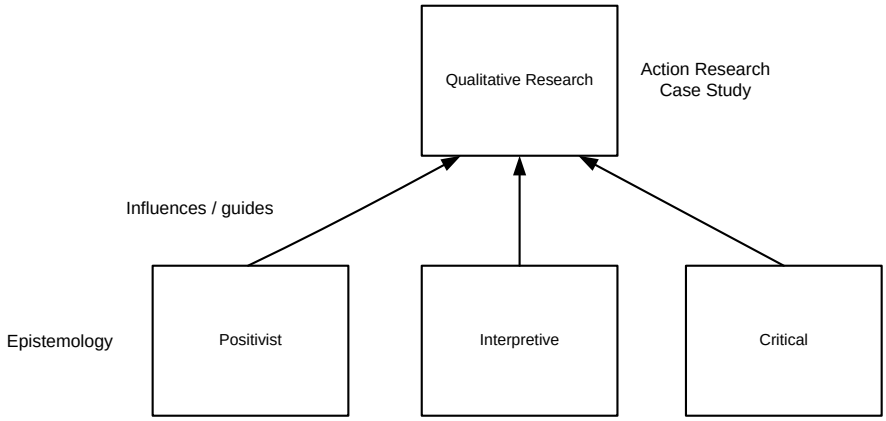

Figure 1 Epistemology and Qualitative Research Methods

We start to discuss research approaches from the viewpoint of epistemology. Next, we take into account the engineering aspect of IS and last we discuss the viewpoint of methodologies.

2.1 Epistemology

Epistemology is a branch of philosophy that studies the nature and scope of knowledge, more specifically it is concerned with what is acceptable knowledge in a certain field. Orlikowski & Baroudi [5] made an inventory of 155 information systems research articles published from 1983 to 1988. They examined the articles for the underlying epistemology and could classify the articles as positivist, interpretive or critical. This classification is also proposed by Chua [6].

Positivism. Positivist studies are primarily meant to test theory. Researcher and object of study are independent. Researchers assume an objective physical and social world that exists independent of human beings. This is the traditional approach of natural and social research (Orlikowski & Baroudi [5]). Applied to IS research, it is applicable for situations where the designer wants to evaluate if the designed artifact works according to the specifications of the design. Because a positive approach doesn't take into account the effect on human beings, this approach is less suited for studying the effect of IS on the human beings that work with the IS.

Interpretivism asserts that reality is a social product and hence incapable of being understood independent of the social actors that construct that social reality. In interpretive research the researcher tries to understand how members of a social group

by their participation in the social processes, help to constitute their social action. So, no objective reality exists and the perception and the importance of subjective meanings is emphasized. Applied to IS research, part of the evaluation is also the evaluation how the designed artifact works in its environment of human actors or in other words the judgment if the designed artifact works according to the user's requirements and, as a consequence of the evaluation results, improve the designed artifact.

Criticism. The critical researcher tries to critically evaluate and transform social reality, this is opposed to the two other two research perspectives that confine themselves to predict or explain social reality. The idea within criticism is that social reality is historically constituted and that by critiquing existing social systems the contradictions and conflicts can be revealed so that people can act to change the existing system. Again, applied to IS research, the designed artifact is not only observed in its working environment, but the researcher also tries to influence the environment. At this moment, we must discern between the following two things: first we have the content of the artifact and second we have the project that implements the artifact. The researcher can have two roles: the role of defining the content of the artifact and / or the role of project leader. The researcher can have the role of project leader in an interpretive or critical setting. Only if the researcher also determines the content of the artifact, we speak of a critical role for the researcher. Thinking of nowadays social reality, where IS is supposed to have a supportive role in organizations, one should be careful in applying the critical approach. This seems to be confirmed by Orlikowski & Baroudi (1991) who classified none of the studied articles as critical.

2.2 Qualitative research methods

A research method is the strategy of inquiry that is used to design the research and collect data. This implies that the research method can be used with every of the three epistemologies. Here, we will discuss action research (AR) and case study research (CSR) as qualitative research methods. As we shall see, AR has much in common with design science research, we will also discuss DSR and the distinction between AR and DSR.

Action research originally aims to contribute to the solution of immediate problematic situations of people and to the body of knowledge of the social science community. It had much difficulties in being acknowledged as a good research approach for IS. Baskerville & Wood-Harper [7] address the relationship between action research and consulting: action researchers are required to defend their method against the challenge that 'this is nothing but consultancy!' At that time Baskerville recognized that action research was not a main stream social science technique, that was transported to the IS field. He thinks that maybe in the IS field action research will finally flourish. In Baskerville & Myers [8] action research has proven its added value in IS research as a method to solve current practical problems while expanding scientific knowledge. The trigger for action research has been the frequent calls for IS researchers to make their research more relevant.

Case study research. The term case study has multiple meanings. It can be used to describe the unit of analysis or to describe a research method. As the unit of analysis, case study can be used in conjunction with e.g. AR. As a research method there are numerous definitions and Yin [9] defines the case study as a research strategy that attempts to examine (a) a contemporary phenomenon in its real-life context especially when (b) the boundaries between phenomenon and context are not clearly evident. Benbasat, Goldstein et al. [10] add to the definition of Yin that multiple methods of data collection are employed to gather information. They sum up a list of 11 key characteristics for case studies, see Table 1.

Table 1 Key characteristics of case studies [10]

1.	Phenomenon is examined in a natural setting
2.	Data are collected by multiple means
3.	One or few entities (person, group or organization) are examined
4.	The complexity of the unit is studied intensively
5.	Case studies are more suitable for the exploration, classification and hypothesis development stages of the knowledge building process; the investigator should have a receptive attitude towards exploration
6.	No experimental controls or manipulation are involved
7.	The investigator may not specify the set of independent and dependent variables in advance
8.	The results derived depend heavily on the integrative powers of the investigator
9.	Changes in site selection and data collection methods should take place as the investigator develops new hypotheses
10.	Case research is useful in the study of 'why' and 'how' questions because these deal with operational links to be traced over time rather than with frequency or incidence
11.	The focus is on contemporary events

Design science. According to March & Smith [11] IT research studies artificial as opposed to natural phenomena, design science is concerned with devising artifacts to attain goals. They define a framework that consists of four types of products (constructs, models, methods and implementations) and four research activities (build, evaluate, theorize and justify). Build and evaluate are design science activities and theorize and justify are natural science activities.

In a later article [12] IS research is characterized by two paradigms: behavioral and design science. From the business-to-IT alignment model from Henderson & Venkatraman [13] the framework from Hevner is extended with a relevance part which provides requirements from the environment (business needs) for the IS research. In [12] IS research is defined as a three cycle method: relevance cycle and

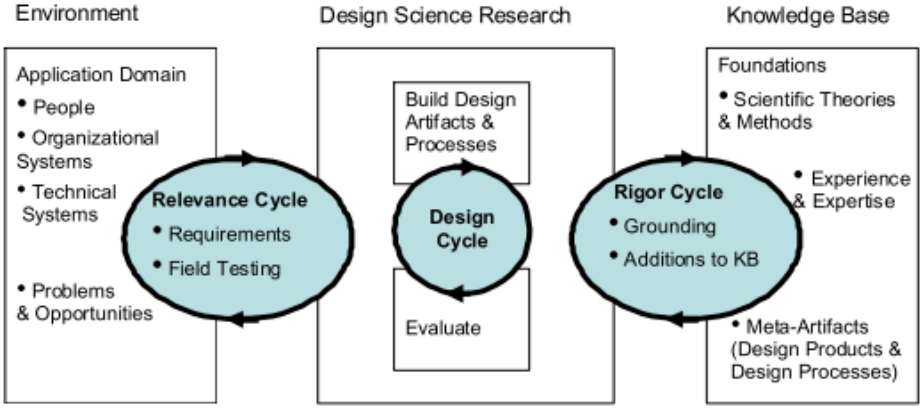

Figure 2 Three cycle view of Design Science from Hevner [12]

rigor cycle with the design cycle in the middle, see Figure 2.

The goal of behavioral-science research is truth (relevance cycle). The goal of design-science research is utility (design cycle). In the rigor cycle the foundations and methodologies that together form the knowledge base, for accomplishing IS research are provided and new additions to the knowledge base are made.

Hevner [12] is a reaction to the essay of Iivari [14] in which is argued that the distinction between IS as a design science and IS as inventions from practitioners, is the specification of a reasonably rigorous constructive research method for building

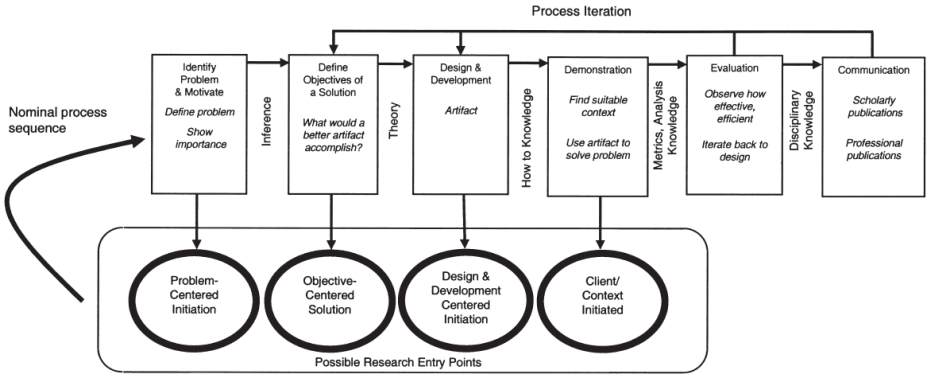

Figure 3 DSRM from Peffers et al. [13]

IT artifacts.

Peffers, Tuunanen *et al* [15] developed a design science research methodology (DSRM), because they felt that the lack of such a methodology in IS research could have contributed to the slow adoption in IS. Peffers *et al* wanted to design a commonly accepted framework. Therefore they studied influential research and used a consensus-building approach to design the framework. This framework consists of six activities and with four possible entry points for research, see Figure 3.

2.3 Differences and similarities between DS and AR

In literature discussion can be found whether action research and design science are similar or not. Iivari [14] differentiates between design science and action science: design science has its roots in engineering and action science has its roots in the socio-technical design movement. Iivari & Venable [16] argue that design science research and action research are decisively dissimilar: they discern on the one hand purely technical problems and innovations and on the other socio-technical problems and innovations. Iivari & Venable [16] argue that design science research focuses on constructing new and innovative ways to solve class(es) of problems, thus creating new reality. In many situations action research is conducted to understand phenomena like the working of complex organizational situations and human behavior and come to improvements to that. So, DS concentrates on constructing new artifacts, while AR concentrates on improving the use of artifacts in their meant environment.

Järvinen [17] argues that action research is similar to design science. He does so by trying to collect the characteristics which describe the nature of action research in general on the one hand and the characteristics of design science on the other hand. He characterizes action research with 7 characteristics and design science with 6 characteristics. He concludes that it seems there is a very high fit between the two sets of characteristics. In table 1 the corresponding characteristics are placed besides one another.

Table 2 Similarities of the fundamental characteristics of action research and design science according to Järvinen [14]

Action Research	Design Science
AR-1: Action Research emphasizes the utility aspect of the future system from the people's point of view.	DS-4: Design science's products are assessed against criteria of value or utility.
AR-2: Action research produces knowledge to guide practice in modification.	DS-2: Design science produces design knowledge (concepts, constructs, models and methods).
AR-3: Action research means both action taking and evaluating.	DS-3: Building and evaluation are the two main activities of design science.
AR-4: Action research is carried out in collaboration between action researcher and the client system.	DS-5: Design science research is initiated by the researcher(s) interested in developing technological rules for a certain type of issue. Each individual case is primarily oriented at solving local problem in close collaboration with the local people.
AR-5: Action research modifies a given reality or develops a new system.	DS-1: Design science solves construction problems (producing new innovations) and improvement problems (improving the performance of existing entities).
AR-6: The researcher intervenes in the problem setting.	DS-5: Design science research is initiated by the researcher(s) interested in developing technological rules for a certain type of issue. Each individual case is primarily oriented at solving local problem in close collaboration with the local people.
AR-7: Knowledge is generated, used, tested an modified in the course of the action research project.	DS-6: Knowledge is generated, used and evaluated through the building action.

So we see that Järvinen [17] and Iivari & Veneble [16] don't disagree so much, but that the involvement of the environment in the evaluation is seen as an important dissimilarity by Iivari & Venable, while Järvinen considers this to be similar.

2.4 Combining AR and DS to overcome problems with traditional AR

Iivari & Venable [16] describe also situations where AR and DS research can be combined. When we take in mind the nowadays practices of software development like Agile and Scrum and also a management method as Lean, it seems that a shift towards AR is driven by the environment to respond faster to its demands (Sein, Henfridsson *et al* [18]). They define IT artifacts as ensembles, by which is reflected that structures of the organizational domain are inscribed into the artifact during its development and use (Sein, Henfridsson *et al* [18]). Orlikowski [19] identifies the prevailing DS approach as "build and *then* evaluate". AR aims at linking theory with

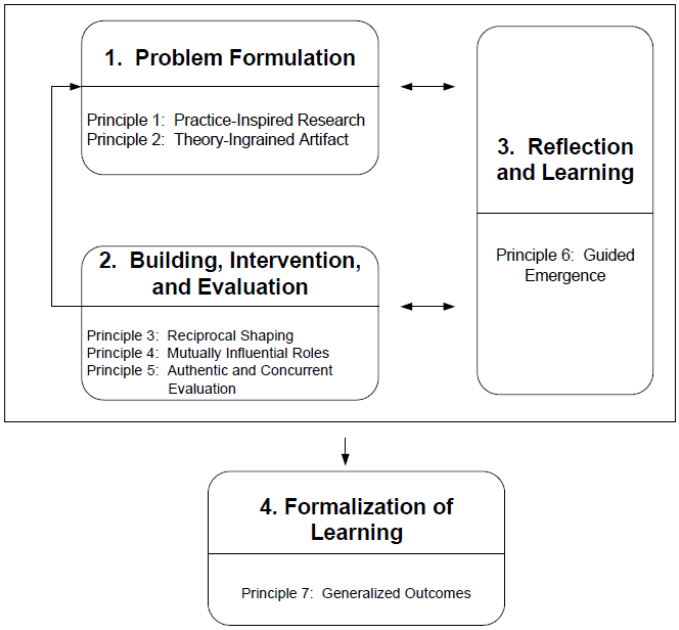

Figure 4 Action Design Research (ADR) acc. Sein et al. [18]

practice, and thinking with doing. They propose to combine the two methods into a new method action design research (ADR) and in this way recognize that the artifact emerges from interaction with the organizational context. The method has 4 stages (problem formulation; building, intervention and evaluation (BIE); reflection and learning; formalization of learning) and 7 principles, see Figure 4. In the BIE-stage they discern IT-dominant BIE and organization-dominant BIE. In IT-dominant BIE artifacts are initially evaluated by practitioners and only more mature artifacts are evaluated by end-users. In organization-dominant BIE where the emphasis is on innovation in organizational intervention, each iteration is evaluated by both practitioners and end-users.

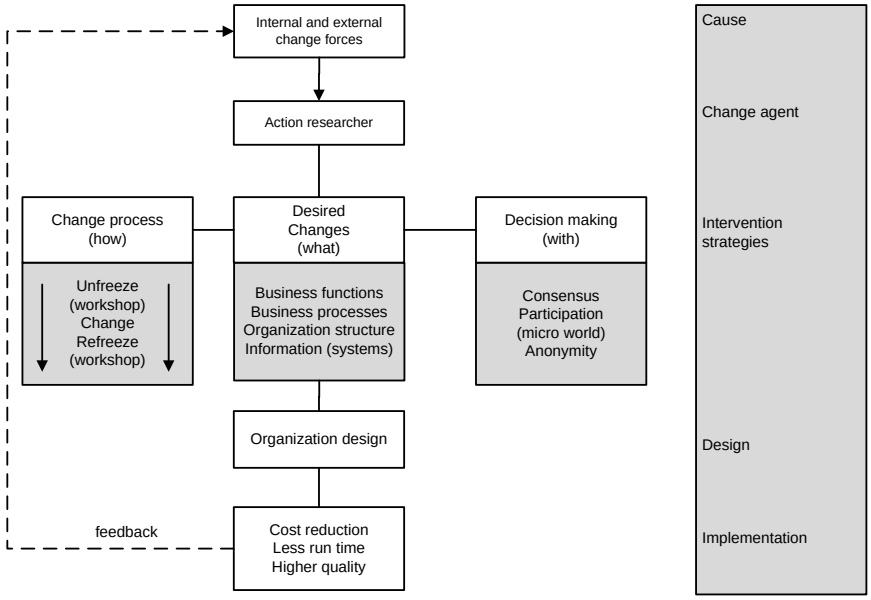

Figure 5 Coherence between project approach and decision making in organization design [20]

Up to this point, we discussed two ways of working in DS and AR. Mulder [20] applied AR and defined a project management method for AR projects, see Figure 5. He clarifies the coherence between a participative project approach and decision making in an organization. He found a large added value of this project management approach. Speed, quality and involvement of parties and by consequence the acceptance of the solution is by far better than a distant expert judgment. A participative approach considers organization design as a change process in which parties unfreeze from their current (undesired) situation, start discovering new possibilities for change and establish this in a new design.

3 Our Research Approach

The objective of our research is to better understand the role of transaction costs in designing enterprises. The notions of Enterprise Ontology and Enterprise Architecture provide the theoretical basis for designing enterprises as networks of transactions. Williamson [21] describes the theory on transaction costs economics. This leads to the first research questions what transaction cost economy is and how to apply this to enterprise design.

This means for our research that we start studying theory and literature on transaction cost economics. The researcher takes in this a positivist position while performing the design cycle and the rigor cycle. This is a necessary step to take for us in order to ground our experiences from practice in theory and existing literature. But on the other hand we think that the value is in applying things. According to

Orlikowski [5] and Figure 1 this means that we need an interpretive or critical stance. The critical stance implies that the researcher wants to change the social reality of the changing organization. This doesn't fit to a role as consultant as we have in our projects. In the project, we take decisions in the project management process and in the change process we propose the solutions and do interventions. According to Figure 1 this means that the researcher needs an interpretive role. As argued in **Fout! Verwijzingsbron niet gevonden.** Literature Review, we follow [23] in using a qualitative approach in our research. We already discussed the differences and similarities between DS and AR ([16], [17], [18] and [19]) and we repeat here that an AR approach fits best in an Agile environment where the use of methods like Scrum and Lean is encountered. We use case studies for defining the unit of analysis. For the setup and execution of projects, we adopt Mulder [20], see Figure 5. In Table 3 we summarize our research approach.

Table 3 Summary of research approach

Objective	Enterprise design using transaction cost
Focal level	Role of transaction costs in enterprise design
Epistemology	Positivist for theoretical study Interpretivist in cases
Research Method	Action Research

3.1 Activities already performed

As part of this research, we will investigate finished DEMO projects for what the added value of DEMO as a method in projects has been. The projects that have been investigated, are known as "DEMO projects" and that means that the people involved in those projects acknowledge it as DEMO project. All projects investigated are claimed to be successful. The investigation has been the conduction of interviews with stakeholders of the projects. Besides that, also interviews with the founders of DEMO have been conducted. There will be two rounds of interviews, the first one more general and the second one will concentrate on specific subjects that have been discovered during the first round as interesting for further investigation. In the period April to June 2012 the first round of interviews has been conducted with founders, project managers, architects, board members of projects and consultants. The projects were diverse in scope, see Table 4.

Table 4 Projects investigated for their application of DEMO

Project name / project organization	Characteristics
VISI	Development of a model of large construction projects and a model for software for exchange of messages for coordination between project partners

Project name / project organization	Characteristics
KLM Air France	Choice of information system for the merger of the two cargo divisions
Rijkswaterstaat	Application Portfolio Rationalization
ING	Implementation of Shared Service Center Securities in a bank

We developed an interview list with questions from different perspectives and with different questions for the different roles. We will not discuss the results of the interviews here, but we confine ourselves to remarking that we are in the process of interpreting the interviews and defining the subjects for the second round of interviews.

4 Conclusions

We argued that it is important in research to discern between different aspects while doing IS research. The philosophical assumptions (*epistemology*) a researcher has, and the *methods* of doing research he uses, determine the scientific relevance of the things he does. In literature, researchers did try to make sharp distinction between different research methods and to prove that one method is better than another. Other authors tried to prove the similarities of different methods and also there are authors who try to combine different methods into one new method. We believe that it makes more sense to make a combination from different available approaches and justify why this combination is best suited for the situation at hand. Providing a solution for the problems enterprises encounter with ever faster changing markets, requires at first the study of theory and other literature with a positivist attitude. But in nowadays world of *Scrum* an *Lean*, applying theory right away in practice is required. For this, AR is an apprpriate approach and the researcher needs an interpretivist stance in applying the solution provided.

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