Developing Information Systems Design Knowledge: A Critical Realist Perspective

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Abstract: Academic Information Systems (IS) research has a serious utilization and relevance problem. To increase IS research utilization and relevance, scholars argue that the mainstream IS research, which is based on the behavioral science paradigm, should be complemented with research based on the design science paradigm. The current IS design science frameworks have a strong focus on the IT artefact, in most cases an exclusive focus on the IT artefact. The frameworks have very little discussion and clarifications regarding underpinning philosophies, but most seem to be based on positivism, traditional realism, or pragmatism. This paper presents an alternative framework for IS design science research. The framework builds on that the aim of IS design science research is to develop practical knowledge for the design and realization of different classes of IS initiatives, where IS are viewed as socio-technical systems and not just IT artefacts. The underpinning philosophy of the framework is critical realism which has been developed as an alternative to positivism and traditional realism as well as to constructivism (relativism). The framework proposes that the output of IS design science research is practical IS design knowledge in the form of field-tested and grounded technological rules. The IS design knowledge is developed through an IS design science research cycle. The paper presents how technological rules can be developed as well as the nature of such rules.

Keywords: Information systems, IS design, frameworks, rules

1. Introduction

In the last years we have seen an intensive debate in the Information Systems (IS) community on the “crisis in the IS field”—see, for example, the debates in the journals *MIS Quarterly* and *Communications of the AIS*. Some commentators argue that part of the crisis is related to the utilization and relevance problem (Hirschheim and Klein, 2003): research not addressing relevant issues and research not producing usable results. To increase IS research utilization and relevance it is argued that the mainstream IS research, which is based on the behavioral science paradigm, should be complemented with research based on the design science paradigm (Walls et al, 1992, 2004; March and Smith, 1995; Hevner et al. 2004).

Research can be divided and classified in different ways. Herbert Simon (1988) in his seminal book “The Sciences of the Artificial” distinguish between “natural sciences” and “sciences of the artificial”. The former focuses on how “things” (natural and social things) are and how they work—for clarity and consistency we will in the rest of the paper use the concept “behavioral science” instead of “natural science”. The sciences of the artificial focus on how to make artefacts and artifical systems having desired properties. Even if it is common to think of engineers, architects, and industrial designers as typical professional designers, Simon stresses that “Everyone designs who devises courses of action aimed at changing existing situations into preferred ones.” Simon’s work on the sciences of the artificial and design science has influenced IS scholars and we have in the last years seen a growing interest in IS design science research and IS design theory/knowledge (Walls et al., 2004); and there is also a fairly new ISWorld web-site on “Design Research in Information Systems” (Vaishnavi and Kuechler, 2005). Interesting IS design science research frameworks have emerged, but from our perspective two major issues have not been carefully addressed. First, there is too little discussion about what IS design science research should include and what should be excluded. This is related to the discussion about what the IS discipline ought to be and what ought to be at the core of the IS discipline. When there is a discussion the view hold is that it is IT artefact design theories that should be developed. Simon’s view on design science points to that it can be more than the IT artefact that the IS field should develop design knowledge for. We will argue that there is a need for IS design science research frameworks having a broader view on IS and IS design knowledge. Second, there is no, or little, discussion about underlying philosophical assumptions in the IS design science research literature. The underlying ontological view an IS design science research framework is built on will ultimately affect how to do IS design science research and what types of outcomes (design knowledge) that can be produced. Although, current frameworks lack in clearness on underpinning philosophies and ontological views, they seem to be based on positivism,

Reference this paper as:
Carlsson S (2005) “Developing Information Systems Design Knowledge: A Critical Realist Perspective” *The Electronic Journal of Business Research Methodology* Volume 3 Issue 2, pp 93-102, available online at www.ejbrm.com

traditional realism, or pragmatism. In IS research based on the behavioral science paradigm there is an increased and fruitful use of alternative philosophies (ontologies), for example, the use of constructivism and critical theory. Consequently, we suggest that it can be fruitful to develop and explore IS design science research frameworks based on alternative philosophies (ontologies).

The remainder of the paper is organized as follows: the next section reviews IS design science research frameworks and elaborates the above two issues. The section argues for a broader view on IS design science research and for grounding IS design science research in the philosophy of critical realism. A short presentation of critical realism follows and this is followed by a presentation of an IS design science research framework based on the philosophy of critical realism. Our work builds on the idea of Pettigrew's (1997) primary double hurdle: IS design science research should meet the criteria of scholarly quality *and* practical (professional) relevance.

2. A review of Information Systems design science research frameworks

Simon's distinction has influenced the IS field. For example, Järvinen (2004) distinguishes between research approaches stressing "what is reality" (behavioral science) and research approaches stressing "utility of artefacts" (design science). Although using different concepts, Walls et al. (1992), March and Smith (1994), and Hevner et al. (2004) make similar distinctions.

Behavioural science is description- and explanatory-driven whereas design science is prescription-driven. Simon argues that there has been a movement towards behavioral science and away from the design sciences in engineering, business and medicine. Although, the IS field is quite young and Simon's book was first published in 1969, reviewing articles published in the leading IS journals reveals a picture where the majority of published articles belong to the behavioral science paradigm (Glass et al., 2004; Chen and Hirschheim, 2004). Based on the IS field's utilization and relevance problem it has been suggested that one way to advance the IS field is to increase IS design science research (Hirschheim and Klein, 2003; Iivari, 2002).

Below we review IS design research frameworks by primarily focusing two issues: 1) what are included in the IS design science research frameworks, and 2) what underlying philosophies (ontologies) have the frameworks. The first issues is related to the discussion on what the IS discipline ought to be and what ought to be at the core of the discipline. The second issue is critical since in all research, including IS design science research, ontology is non-optional (Fleetwood, 2004).

As far as we know, the first article on developing IS design theories (ISDT) and IS design knowledge was published in 1992 (Walls et al., 1992). Walls et al. argue that successful construction of ISDT would create an endogenous base for theory in the IS discipline, and could be used by scholars to prescribe design products and processes for different classes of IS as they emerged. The authors build on Simon's distinction and argue that design is both a *product* and a *process*, which means that a design theory must have two aspects—one that deals with the product of design and one that deals with the process of design. Using their framework the authors proposed an ISDT for the IS-class "Vigilant Information Systems." The components of an IS design theory are summarized in Table 1.

Walls et al. use the concept "artefact" quite freely, but in reflecting on their 1992-paper they say: "We did not use the current phrase "IT artefact", but in essence it was that to which we were referring." (Walls et al., 2004).

Building on Simon's ideas, March and Smith (1995) distinguish between design sciences and natural sciences. The former involves building and evaluating: 1) *constructs* which are "concepts with which to … characterize phenomenon", 2) *models* that "describe tasks, situations, or artefacts", 3) *methods* as "ways of performing goal directed activities", and 4) *instantiations* which are "physical implementations intended to perform certain tasks".

Table 1: Components of an IS design theory (Walls et al., 1992)

Design Product		
1.	Meta-requirements	Describes the class of goals to which the theory applies
2.	Meta-design	Describes a class of artefacts hypothesized to meet the meta-requirements
3.	Kernel theories	Theories from natural or social sciences governing design requirements

Design Product		
4.	Testable design product hypotheses	Used to test whether the meta-design hypotheses satisfies the meta-requirements
Design Process		
1.	Design method	A description of procedure(s) for artefact construction
2.	Kernel theories	Theories from natural or social sciences governing design process itself
3.	Testable design process hypotheses	Used to verify whether the design hypotheses method results in an artefact which is consistent with the meta-design

Hevner et al. (2004), building on March and Smith, present a design science framework and guidelines around building and evaluating IT artefacts—Figure 1 depicts their IS research framework.

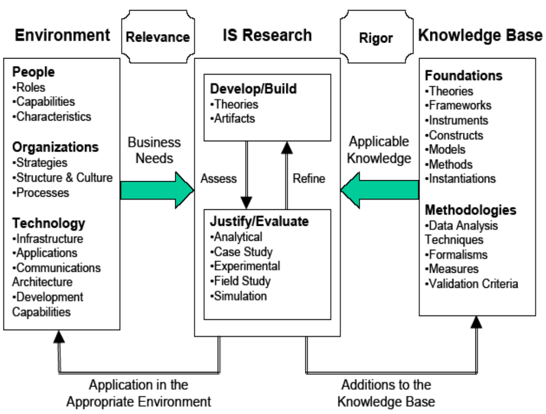

Figure 1: IS research framework (Hevner et al., 2004).

Hevner et al. expressed their view on what constitute good IS design science in the form of seven guidelines. The authors contend that each of the guidelines should be addressed in some manner for IS design science research to be complete. Guideline one—"design as an artefact"—says: "Design-science research must produce a viable artefact in the form of a *construct*, a *model*, a *method*, or an *instantiation*." (Hevner et al. 2004, italics added to indicate similarity with March and Smith's output view). And, the "result of design-science research in IS is, by definition, a purposeful IT artefact created to address an important organizational problem. … Our [Hevner et al.'s] definition of IT artefacts is both broader and narrower [than other IT artefact definitions] … It is broader in the sense that we include not only instantiations in our definition of the IT artefact but also the constructs, models, and methods applied in the development and use of information systems. However, it is narrower in the sense that we do not include people or elements of organizations in our definition nor do we explicitly include the process by which such artefacts evolve over time."

Regarding what should be included in an IS design research framework, and consequently in IS design theory and knowledge, it is clear that Walls et al., March and Smith, and Hevner et al. have the IT artefact as the subject. They exclude the non-technological context by excluding people and organizations. Given, the frameworks' focus and what the exclude the framework might better be named IT design science research frameworks.

Benbasat and Zmud (2003) suggest that the core of the IS discipline and IS research should be the IT artefact—a narrow view on the IS discipline and IS research. Alter (2003) suggests a broader view and argues that the core of the IS discipline should be "work systems". The above IS design science research papers have views more in line with Benbasat and Zmud's view than with Alter's view. In the IS core debate, Myers (2002) argues for that the IS discipline is nowhere near ready to define an IS core—he argues for open, flexible, and adaptive views. Hence, he argues for broad and emergent views on the IS core. Said Myers: "I believe that diversity is a positive attribute and ensures the continued viability of the field in a rapidly changing environment." (Myers, 2002) We agree entirely with Myers. It should be noted that Walls et al. and Hevner et al. say that IS design theories and framework can encompass more than the IT artefact. Furthermore, Hevner et al's second design guideline—problem relevance—states: "The objective of design-science research is to develop technology-based solutions to important and relevant business problems". (Hevner et al. 2004). It can be noted that lists ranking current and future critical IS-issues, for example published by the Gartner Group, often have non-technological issues as the most critical (relevant) and less easy to solve issues, for example, "how to align our business strategy and IT strategy".

Our view is that an IS design science research framework should be based in what should be produced, that is, what kind of knowledge should be developed. We suggest that the aim of IS design science research is to develop practical knowledge for the design and realization of "IS initiatives" or to be used in the improvement of the performance of existing IS. By an IS initiative we mean the design and implementation of an intervention in a social-technical system and where IS (including IT artefact) is a critical mean for achieving the desired outcomes of the intervention.

The second issue we address is underpinning philosophies and ontologies of the frameworks. The above IS design science research papers do not explicitly address ontology, but ontology is non-optional in all research (Fleetwood, 2004). Although, the above papers do not address underpinning philosophies and ontologies, it is possible to conclude that they are based in positivism, traditional realism, or pragmatism. This conclusion is based on the few philosophical and philosophy of science references used by the authors and that they use words like "prove"; and Hevner et al. explicitly refers to pragmatism. The ISWorld web-site on "Design Research in Information Systems" has a section on the "philosophical grounding of design research" (Vaishnavi and Kuechler, 2005). Unfortunately, the authors mix concepts and definitions and their use of key concepts are inconsistent with what is found in the philosophy and philosophy of science literature. For example, they say that "ontological and epistemological viewpoints shift in design research as the project runs through circumscription cycles ... This iteration is similar to but more radical than the hermeneutic processes used in some interpretive research." This means that in IS design science research a researcher's assumptions about how the world is "constructed" should change during a research project! What the authors probably mean is that our knowledge of the world changes which is quite a different matter. They also make what Bhaskar (1978) terms an "epistemic fallacy" in that they transpose what is an ontological matter—concerning what exists—into an epistemological matter of how to develop reliable knowledge. It is interesting to note that the authors make a reference (using Mario Bunge's work) to critical realism: "Bunge (1984) implies that design research is most effective when its practitioners shift between pragmatic and critical realist perspectives, guided by a pragmatic assessment of progress in the design cycle." (Vaishnavi and Kuechler, 2005). Unfortunately, they do not explore Bunge's view.

To summarize, papers on IS design theory and knowledge or IS design science research do almost never explicitly discuss ontological issues and underpinning philosophies, but most papers seem to be based in positivism, traditional realism, and pragmatism. This is consistent with studies on publications in the IS field. The overwhelming majority of papers are based on a positivistic philosophy (Chen and Hirschheim, 2004). IS research commentators point out weaknesses in positivism, etc., and suggest the use of alternative philosophies, like constructivism and critical theory—for examples, see the chapters in Mingers and Willcocks (2004) and Whitman and Woszczynski (2004). This paper articulates a view on IS design science research based on the philosophy of critical realism which is an alternative to positivism as well as to constructivism.

3. Critical Realism

Critical realism (CR) was developed as an alternative to positivism (empiricism) and as an alternative to non-positivism, e.g. constructivism (relativism). The most influential writer on critical realism is Roy Bhaskar (1978, 1989, 1998, 2002). Unfortunately, Bhaskar is an opaque writer, but clear summaries of critical realism are found in Archer et al. (2000) and Chapter One in Bhaskar (2002).

Critical realism can be seen as a specific form of realism. Its manifesto is to recognize the reality of the natural order and the events and discourses of the social world. It holds that "we will only be able to understand—and so change—the social world if we identify the structures at work that generate those events or discourses … These structures are not spontaneously apparent in the observable pattern of events; they can only be identified through the practical and theoretical work of the social sciences." (Bhaskar, 1989). Bhaskar (1978) outlines what he calls three domains: the *real*, the *actual*, and the *empirical* (Table 2). The *real* domain consists of underlying structures and mechanisms, and relations; events and behavior; and experiences. The generative mechanisms residing in the real domain exist independently of, but capable of producing, patterns of events. Relations generate behaviors in the social world. The domain of the *actual* consists of these events and behaviors. Hence, the actual domain is the domain in which observed events or observed patterns of events occur. The domain of the *empirical* consists of what we experience; hence, it is the domain of experienced events.

Table 2: Ontological assumptions of the critical realist view of science (Bhaskar, 1978)

	Domain of Real	Domain of Actual	Domain of Empirical
Mechanisms	X		
Events	X	X	
Experiences	X	X	X

Xs indicate the domain of reality in which mechanisms, events, and experiences, respectively reside, as well as the domains involved for such a residence to be possible.

Bhaskar argues that; "…real structures exist independently of and are often out of phase with the actual patterns of events. Indeed it is only because of the latter we need to perform experiments and only because of the former that we can make sense of our performances of them. Similarly it can be shown to be a condition of the intelligibility of perception that events occur independently of experiences. And experiences are often (epistemically speaking) 'out of phase' with events — e.g. when they are misidentified. It is partly because of this possibility that the scientist needs a scientific education or training. Thus I [Bhaskar] will argue that what I call the domains of the real, the actual and the empirical are distinct." (Bhaskar 1978). Critical realism also argues that the real world is ontologically stratified and differentiated. The real world consists of a plurality of structures and generative mechanisms that generate the events that occur and do not occur. From an epistemological stance, concerning the nature of knowledge claim, the realist approach is non-positivistic which means that values and facts are intertwined and hard to disentangle.

The literature on the philosophy of science discusses the differences between positivism, constructivism, and critical realism; for example, discussions on their ontological views. Good discussions in terms of doing real world research based on the different philosophies of sciences are available in Robson (2002) and Bryman (2001). Table 3 summarizes a critical realism view of science.

Table 3: A realist view of science (Robson, 2002)

1	There is no unquestionable foundation for science, no 'facts' that are beyond dispute. Knowledge is a social and historical product. 'Facts' are theory-laden.
2	The task of science is to invent theories to explain the real world, and to test these theories by rational criteria.
3	Explanation is concerned with how mechanisms produce events. The guiding metaphors are of structures and mechanisms in reality rather than phenomena and events.
4	A law is the characteristic pattern of activity or tendency of a mechanism. Laws are statements about things that are 'really' happening, the ongoing ways of acting of independently existing things, which may not be expressed on the level of events.
5	The real world is not only very complex but also stratified into different layers. Social reality incorporates individual, group and institutional, and societal levels.
6	The conception of causation is one in which entities act as a function of their basic structure.
7	Explanation is showing how some event has occurred in a particular case. Events are to be explained even when they cannot be predicted.

Critical realism is a well-developed philosophy of science, but on the methodological level it is less well-developed. The writings of Derek Layder (1993, 1998) and Mansor Kazi (2003), as well as some of the chapters in Ackroyd and Fleetwood (2000) and Fleetwood and Ackroyd (2004), can serve as guidelines for doing research based on critical realism. Unfortunately, from an IS design science research perspective, most of the writings have been in the behavioral science paradigm, i.e., for theory development and theory "testing".

Critical realism has influenced a number of social science fields, e.g., management and organization studies. With few exceptions, CR is almost invisible in the IS field. Mingers (2004), Mutch (2002), Carlsson (2004), and Dobson (2001) argue for the use of critical realism in IS research and discuss how this can overcome problems associated with positivism and constructivism. The writings on CR in IS have been focusing on the use of CR in the behavioral science paradigm and not in the design science paradigm. This paper uses CR as an underpinning philosophy for IS design science research.

4. Developing Information Systems design knowledge

This section presents and discusses an IS design science research framework based on critical realism. It starts with discussing what types of knowledge should be produced and for whom. This followed by a presentation of how IS design knowledge can be produced.

4.1 For whom should IS design research produce knowledge?

The primary constituent community for the output of IS design research is the professionals in the IS field. This means primarily professionals who plan, manage and govern, design, build, implement, operate, maintain and evaluate different types of IS. The developed IS design knowledge is to be applied by individuals who have received formal education (or a similar training) in the IS field. An IS-professional can be defined as a member of a fairly well-defined group who solves real-world IS-problems with the help of skills, creativity and (scientific) IS-design knowledge. (For simplicity we call the problems IS-problems although it is more correct to say that someone has defined a problem where one, for one reason or another, has decided to solve the problem with an IS-initiative). Another important community is IS education, which means that the knowledge should be useful in different types of IS study programs.

Although, the primary community works in organizations driven by profit (utility) “maximization”, it should be stressed that CR also has a critical and emancipatory component. The frameworks discussed in section 2 have a clear management perspective and certainly not an emancipatory or critical stance. The emancipatory and critical issue is important, but here we just note it and leave the issue for further exploration and development.

4.2 What types of IS design knowledge can IS design research produce?

IS design science research should develop practical knowledge to solve a class of IS-problems. This means the development of abstract knowledge that can be used in designing and implementing IS initiatives. It is abstract in the sense that it is not a recipe for developing the X-IS-initiative for the Z-organization. A user of the abstract design knowledge has to ”transform” it to fit the specific situation and context. The knowledge takes the form of field-tested and grounded technological rules—will be discussed below.

Following Pelz (1978), we can distinguish between conceptual and instrumental use of science. The former involves using knowledge for general enlightenment on the subject in question and the latter involves acting on research results in specific and direct ways. Although both types are relevant we focus on the development of design knowledge for instrumental use.

Using van Aken’s (2004) classification we can distinguish three different designs an IS professional makes when developing an IS-initiative: 1) an *object*-design, which is the design of the IS intervention (initiative), 2) a *realization*-design, which is the plan for the implementation of the IS intervention (initiative), and 3) a *process*-design, which is the professional’s own plan for the problem solving cycle and includes the methods and techniques to be used to design the solution (IS intervention) to the problem. IS design science research should produce knowledge that can be used by the professionals in the three types of designs.

4.3 Design knowledge as field-tested and grounded technological rules

Following Bunge (1967), we can say that design science research aims at developing stable norms of successful human behavior, i.e. rules. Van Aken (based on Bunge) defines a technological rule as ”…an instruction to perform a finite number of acts in a given order and with a given aim.” (Bunge, 1967); and a technological rule is ”*a chunk of general knowledge, linking an intervention or artefact with a desired outcome or performance in a certain field of application”*. (van Aken, 2004). A technological rule is general, which for IS design knowledge means that a rule is a general prescription for a class of IS-problems and not a specific prescription for a specific situation (for the X-IS-intervention in organization Z). Since a technological rule should be used by practitioner it should be applicable and actionable. Generally, the form of the technological rules is like “if you want to achieve A (outcome) in situation B (problem) and C (context), then something like action/intervention D can help because E (reason)”. Something like action/intervention D means that the rule is to be used as a design exemplar.

A field-tested and grounded technological rule has been tested empirically and is grounded in science. The latter means primarily grounding in results and theories from the behavioral science paradigm. How to develop and test technological rules will be presented in Section 4.4. Field-tested and grounded technological rules will in most cases be in the form of heuristics. This is consistent with critical realism and means that the indeterminate nature of a heuristic technological rule makes it impossible to prove its effects conclusively, but it can be tested in context, which in turn can lead to sufficient supporting evidence.

4.4 Developing IS design knowledge

Van Aken (2004) suggests that management theory design science has much in common with evaluation research of social programs based on the philosophy of critical realism. We agree entirely with van Aken and suggest that evaluation research based on CR can make a major contribution to IS design science research. Related work has started on developing a critical realistic IS evaluation perspective (Carlsson, 2003) which builds on critical realism and realistic evaluation (Pawson and Tilley, 1997; Kazi, 2003; Mark et al., 2000). In our IS design science research framework the intention is to produce ever more detailed answers to the question of *why* and *how* an IS initiative works, for *whom,* and in *what* circumstances. Using the framework means that a researcher attends to how and why an IS initiative has the potential to cause the (desired) change. In this perspective, an IS design science (ISDS) researcher works as an experimental scientist, but not according to the logics of the traditional experimental evaluation research. Bhaskar states: "The experimental scientist must perform two essential functions in an experiment. First, he must trigger the mechanism under study to ensure that it is active; and secondly, he must prevent any interference with the operation of the mechanism. These activities could be designated as 'experimental production' and 'experimental control'." (Bhaskar 1998). Figure 2 depicts the realist experiment.

ISDS researchers do not perceive that IS initiatives "work". It is the actions of the stakeholders that make them work, and the causal potential of an IS initiative takes the form of providing the reasons and resources to enable different stakeholders and participants to "make" changes. This means that an ISDS researcher seeks to understand *why* and *how* an IS initiative, for example, the implementation of a CRM systems, works through understanding the action mechanisms. It also means that an ISDS researcher seeks to understand *for whom* and *in what circumstances (contexts)* an IS initiative works through the study of contextual conditioning.

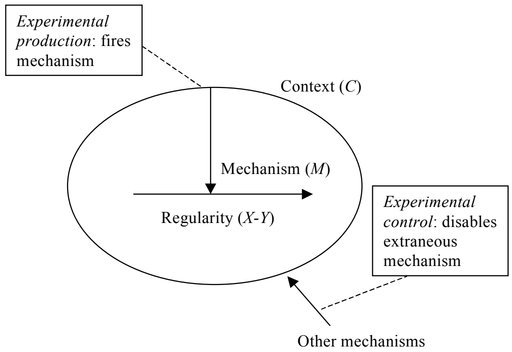

Figure 2: The realist experiment (Pawson and Tilley 1997).

ISDS researchers orient their thinking to context-mechanism-outcome pattern configurations (CMO configurations). This leads to the development of transferable and cumulative lessons from ISDS research. A CMO configuration is a proposition stating what it is about an IS-initiative which works for whom in what circumstances. A refined CMO configuration is the finding of an evaluation of an IS initiative.

ISDS researchers examine outcome patterns in a theory-testing role. This means that an ISDS researcher tries to understand what the outcomes of an IS initiative are and how the outcomes are produced. Hence, the researcher does not just inspect outcomes in order to see if an IS-initiative works, but analyzes the outcomes to discover if the conjectured mechanism/context theories are confirmed.

In terms of generalization, an ISDS researcher through a process of CMO configuration abstraction creates "middle-range" theories. These theories provide analytical frameworks for interpreting differences and similarities between classes of IS-initiatives. Given that the goal is to develop design theories and knowledge—to construct and test context-mechanism-outcome pattern explanations—for practitioners ISDS researchers need to engage in a teacher-learner relationship with IS practitioners.

ISDS research employs no standard research design formula. The base strategy is to develop a clear theory of IS initiative mechanisms, contexts and outcomes. Given the base strategy, an ISDS researcher has to design appropriate empirical methods, measures, and comparisons. ISDS research is supportive of the use of both quantitative and qualitative methods.

ISDS research based on the above can be carried out through an IS design science research cycle (Figure 3). The starting point is theory. Theory includes propositions on how the mechanisms introduced by an IS-invention into a pre-existing context can generate outcomes. This entails theoretical analysis of mechanisms, contexts, and expected outcomes. This is the first step in developing technological rules and means that one tries to generate technological rules using our current knowledge, that is, grounding in theory. The second step consists of generating more specific "hypotheses". Typically the following questions would be addressed in the hypotheses: 1) what changes or outcomes will be brought about by an IS-intervention (initiative), 2) what contexts impinge on this, and 3) what mechanisms (social, cultural and others) would enable these changes, and which one may disable the intervention. In this step the technological rules are refined.

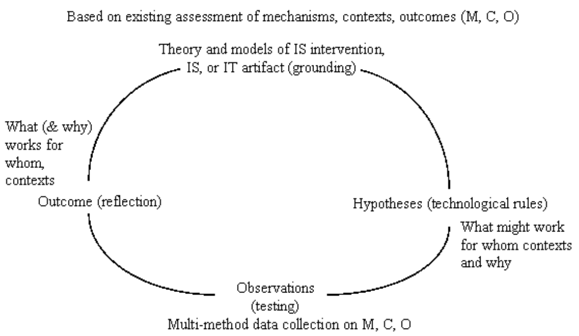

Figure 3: The Information Systems design science research cycle—based on Pawson and Tilley (1997) and Kazi (2003)

The third step is the empirical test and includes selection of appropriate data collection methods. ISDS research is supportive of: 1) the use of both quantitative and qualitative evaluation methods, 2) the use of extensive and intensive research design, and 3) the use of fixed and flexible research design. In this step it might be possible to generate evidence of the IS-intervention's ability to change reality. Based on the result from the third step, we may return to the IS-intervention to make it more specific as an intervention of practice. Next, but not finally, we return to theory. The theory may be developed, the hypotheses and the technological rules refined, the data collection methods enhanced, etc. To develop the technological rules means that the cycle will be repeated. As said above most of the technological rules will be heuristic. Through multiple case-studies one can accumulate supporting evidence which can continue until 'theoretical saturation' has been obtained.

5. Conclusion and further research

This paper points out some limitations and weaknesses in the current IS design science research frameworks and suggests that critical realism (CR) could be a fruitful philosophical underpinning for IS design science research and an IS design science framework. We presented a framework based in critical realism and having a broader view on what types of knowledge IS design science research should produce. This broader view is a direct consequence of that we do not just focus the IT artefact, but instead focus IS. Our framework can be summarized as (adapted from van Aken, 2004):

Characteristic	*IS design science research framework*
Dominant paradigm	Design sciences
Focus	Solution focused
Perspective	Researcher as experimenter (player)
Logic	Intervention-outcome
Typical research question	Alternative IS interventions for a class of problems
Typical research product	Tested and grounded technological rules (design knowledge)
Nature of research product	Heuristic
Justification	Saturated evidence
Type of resulting theory	Practical and abstract IS design theory and knowledge

Further theoretical and empirical work is required to develop and test the use of CR in IS design science research. Our suggestions make no claims to be the final word in the debate on IS design science research, but research based on the framework can lead to a stream of research that can develop high scholarly quality *and* practical (professional) IS design science knowledge.

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