

On Epistemological Pluralism in Design Science

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1 A Problem-Oriented Introduction

Design Science is an old hat, but why is a debate on design science in today's IS research so necessary? Here, I would like to make an argument from my personal perspective, reflecting the German research tradition, which is—in great parts—strongly oriented towards design science research (Niehaves 2006). What Iivari (2007) mentioned holds true in this case as well: Nobody uses the term design science research—not even in German. On major German IS conferences (for instance, Wirtschaftsinformatik) there is no 'Design Science' track as, for instance, on ICIS 2006. Instead, design-oriented research can be somewhat regarded as the dominant, but implicit research perspective. Design-oriented research is considered as a viable mean to produce results that are of great relevance for business practice. This also reflects in the fact that industry is an important (direct) funding source for (academic) research projects in Germany. However, a major deficiency is that methodological and epistemological issues remain implicit in the majority of German IS publications (Heinrich 2005). A literature analysis of the major German-speaking IS research journal 'Wirtschaftsinformatik' (volumes 1990 to 2004 with 539 articles published) proved that only 10.9 % of the articles elucidate their research methodology (Heinrich 2005). To my opinion, this is alarming. I have to leave it open, if such deficit holds true for other design-oriented research works, as to ask "Do research papers explain their research methodology?" might be a rather surprising enquiry. Though I don't value black and white views, design-oriented research, as to be found at least in the German IS community, seems to strongly tend towards relevance rather than rigour. A question of mindset?

Iivari (2007) argues that mainstream IS research has been strongly influenced by "the hegemony of North-American business-school-oriented IS researchers over the leading IS publication outlets" and that the corresponding

cumulative, theory-based research strategy seems to have “seriously failed to produce results that are of real interest in practice.” Here, an examination of articles published from 1991 to 2001 in, for instance, US journals, revealed that at a methodological level quantitative methods are applied in 71% of the cases in the sample (Chen and Hirschheim 2004). The underlying view of nature in especially US-American IS research is that the world has an objective reality (Hirschheim 1985). While such assumption of an underlying ‘reality’ is often referred to as realist ontology, positivism furthermore assumes that, at least in principle, it is possible to achieve ‘objective knowledge’ of that real world (Becker and Niehaves 2007). Consequently, the rigour imperative is to reduce (and best to exclude) the researcher’s influence in the process of achieving (in principle) ‘objective’ knowledge. Chen & Hirschheim (2004) found that in US-based journals 89% of the research papers take such positivist perspective. Here, one has to ask the question of what is the reason behind this situation. Is it a dominance of positivist thoughts out there or is it that positivism and journal publications are inherently connected (regardless of the great examples of interpretivist research)? Is it a dominance of quantitative-empirical behavioural research or is it that design-oriented research just prefers other outlets? So again, a question of mindset?

Taking my German perspective and emphasizing existing research methodological and rigour deficits (Heinrich 2005), what are the main triggers for rethinking current design-oriented research? From the perspective of German IS research, a growing internationalisation of research can be observed. This means, against the background of strongly different research traditions (for instance, in design-orientation in Germany and positivist quantitative research the US), that a rather ‘closed system’ becomes more open and oriented towards the international discussion. Main triggers are, for instance:

- an internationalisation of research projects, as exemplified by the increasing funding of EU Framework Research Programmes (FRP) (from 13,7 billion € for the 5th EU FRP from 1998-2002, to 30 billion € for the 7th EU FRP from 2007-2010) (<http://www.cordis.lu>),
- an internationalisation of publication culture: journal rankings relevant for academic careers in Germany—published by the Society of German University Professors VHB—show the highest ranked German-speaking IS journal ‘Wirtschaftsinformatik’ only on position 126,
- academic career culture: for instance, cumulative PhD dissertations establishing nowadays as a viable choice in Germany, and
- accordingly an internationalisation of institutions, with international academic research networks.

Furthermore, there is an intrinsic motivation. We are not (only) designers, but ‘design scientists’, ‘design researchers’, or ‘design science researchers’. This means that we typically have the obligation to contribute to the body of knowledge (Hevner et al. 2004). Practical relevance is not enough. Therefore, I very much welcome Iivari’s (2007) assessment of the recent discussion in design science research: current contributions have “turned our attention to how to do design science research. One can expect that this will make future design science research more rigorous and researchers more reflective over the research process. (p. 2)” To my interpretation, this statement makes a significant implication: it’s not ‘rigour vs. relevance’, but ‘rigour and relevance’. At this point, I agree with Iivari (2007) that design research offers great potential to produce ‘relevant’ results that are of real interest in practice.

However, I still see a significant shortcoming when it comes to discussing research rigour in design science. While Hevner et al. (2004) make an important contribution in terms of guidelines for conducting and evaluating design science research, the question of epistemology often remains rather implicit. Nonetheless, the understanding of such concepts as ‘research rigour’, ‘research validity’ and also ‘research quality’ heavily depends on the underlying epistemological understanding, also in design science. At current, however, many authors advocating the stance of design science often neglect the influence of basic philosophical and epistemological issues on design science. “The major emphasis of such debates [on positivism and interpretivism] lies in the epistemologies of research, the underlying assumption being that of natural sciences [, not of design science]” (Hevner et al. 2004, p. 98). Here, design science is often, to my understanding incorrectly, advocated as a third paradigm that adds up to positivism and interpretivism (Vaishnavi and Kuechler 2006). However, an epistemological reflection of design science research is not yet to be found to a sufficient extent (see McKay and Marshall 2005; background, for instance, in Schön 1983 or Mathiassen 1998). Though several efforts were made in order to theorise design science (cf., Hevner et al. 2004; Lee 2000; March and Smith 1995; Nunamaker et al. 1991; Walls et al. 1992), an explicit epistemological stance has not yet been taken. Therefore, I would like to take Iivari’s (2007) argument on design science epistemology further down the road. Is there an epistemology of design science? Is design science open to diverse epistemologies? And how does the discussion of design science relate to the discussion of epistemology, for instance positivism and interpretivism?

2 Epistemological Perspectives on Design Science Research

The question of epistemology is not separate from, but inherent to design science research (evaluation). Epistemology is concerned with the question of how to achieve ‘true knowledge.’ It specifically addresses the question of what is the relation between the object of knowledge and the knowledge achieved and, at this point, elaborates the influence of the subject on the process of achieving knowledge: Is knowledge potentially objective or subjectively influenced? While some authors argue that design science research is a third paradigm that adds up to interpretivism and positivism (see, for instance, Vaishnavi and Kuechler 2006), I will argue that epistemological assumptions are also underlying to design science research and that they heavily impact on how such design science research can be conducted and evaluated. This is one of the points where I agree with Iivari (2007). An argument provided to understand design science as a ‘third paradigm’ is that design science is concerned with designing artefacts while only behavioural science would seek to produce ‘true knowledge’ in terms of certain justified theories. At this juncture, I will refer to the discussion of what separates design science from design practice: It is a contribution to the body of design knowledge. Design practice is rather concerned with applying existing knowledge, while design science research seeks to add new knowledge to the existing body of knowledge, for instance, in terms of design theories (Markus et al. 2002; Walls et al. 1992). In order to be able to assess the quality of such potential contribution to the body of design knowledge and in order to evaluate the (research) process which led to this knowledge, Hevner et al. (2004) suggest design science research guidelines. These guidelines seek to aid achieving and evaluating design knowledge. At this point, Iivari (2007) provides a valuable differentiation of different types of design knowledge (p. 46):

1. Conceptual knowledge (no truth value), e.g., system concepts and ontologies,
2. Descriptive knowledge (truth value), e.g., ‘X causes A in situation B’, and
3. Prescriptive knowledge (no truth value), e.g., ‘in order to achieve A, apply X’.

Regarding descriptive knowledge (point 2), it should be obvious that the question of epistemology, which is the question of how to achieve ‘true knowledge’, is not separate from design science research, but that both concepts are inevitably intertwined. But what about conceptual and prescriptive

knowledge which both are considered not to have a truth value? We have to discuss if IS research practice really deals with pure conceptual or prescriptive knowledge. Are those different types of knowledge not always attached? Here, on the one hand Iivari (2007) emphasizes “the irreducibility of prescriptive knowledge of IT artifacts to theoretical descriptive knowledge” (p. 39). On the other hand, it is said that:

The strong theory orientation of the leading IS journals may exaggerate the dependence of prescriptive knowledge on descriptive knowledge, I would consider the existence of a kernel theory to be a defining characteristic of a ‘design theory’. As a consequence, I claim that without a sound kernel theory it is not justified to speak about ‘design theory’. (p. 49)

To my perspective, the question of in how far design science research deals with pure prescriptive knowledge is still open at this point. Here, I agree with the argument that, due to a certain research culture, descriptive knowledge is often overemphasized, for instance, in the context of a cumulative, theory-based research tradition. However, does the ‘practice of design science research’, our daily work, really deal with pure prescriptive knowledge? I don’t want to discuss the theoretical existence of pure prescriptive knowledge at this point, this issue is still open. Instead, I would like to discuss in how far a practical piece of design science research can purely rely on prescriptive knowledge. If design researchers seek to communicate their research results, for instance, reference models, procedural models, implementations, modelling grammars, can they just come up with the pure results? No matter what the editorial policy of certain IS journals might be, researchers most habitually seek to give ‘good reasons’ why their results might be useful. Most often, design researchers are required to provide empirical testing of their prescriptive results within the same communication, e.g. a journal paper. Thus, even prescriptive knowledge is inevitably embedded in a system of theoretical, descriptive, and empirical knowledge. Therefore, in the following section, I would like to epistemologically analyse some of Hevner et al.’s (2004) design science research guidelines in order to elaborate this argument.

3 Epistemological Reflection on Design Science Research Guidelines

In the previous section, I sought to provide arguments against the seemingly common knowledge that design science would be a ‘third paradigm’ adding up to positivism and interpretivism (among other epistemologies). The ques-

tion of epistemology and the question of design science research (evaluation) are inseparably intertwined (see also, for instance, McKay and Marshall 2005; Niehaves and Stahl 2006; Schön 1983). Thus, I tried to further elaborate and operationalise Iivari's (2007) epistemological argument for design science research. Additionally, I argued that the knowledge relevant in 'the practice of design science research' is embedded in a system of theoretical, descriptive, and empirical knowledge. Even though certain pieces of design science might seek to provide prescriptive knowledge (without a truth value), such endeavour is thus still subject to epistemology.

In recent IS literature an extensive discussion of positivist and interpretivist epistemologies can be found (for instance, Becker and Niehaves 2007; Chen and Hirschheim 2004; Fitzgerald and Howcroft 1998; Hirschheim and Klein 1989; Iivari et al. 1998; Lee 1991; Monod 2003; Weber 2004). Epistemological, ontological, and methodological assumptions were those mainly taken into account in order to identify and to describe distinct (IS) research paradigms, most often positivism and interpretivism (Becker and Niehaves 2007). However, in IS research literature divergent streams of thought can be found regarding the definition of positivism and interpretivism (Niehaves and Stahl 2006). Here, I will assume that positivism and interpretivism feature distinct epistemological assumptions, but share the ontological assumption. For instance, Weber (2004) argues that both positivism and interpretivism share the assumption that a 'real world' exists beyond the realms of human cognition. However, epistemologically, positivism on the one hand assumes that there exists in principle the possibility that objective knowledge about this real world can be achieved. On the other hand, interpretivism epistemologically emphasizes that knowledge is always determined by the subject and, thus, no such thing as objective knowledge exists (see, for instance, Weber 2004).

At present, the discussion under the label of 'design science research' follows a rather implicit positivist epistemology. Literature provides us with a comprehensive discussion of design science research evaluation in terms of design science research guidelines (Hevner et al. 2004). Here, I argue—agreeing with Iivari (2007)—that the question of epistemology cannot be separated from this discussion. Nonetheless, at the current state, for instance McKay and Marshall (2005) have analysed that one can observe a more or less positivist epistemology in the notion of design science. In the following, I will therefore refer to the interpretive principles suggested by Klein and Myers (1999) in order to reflect on Hevner et al.'s (2004) design science research guidelines. I will formulate core questions from an interpretive stance that may arise when discussing selected design science research guidelines (Niehaves and Becker 2006):

Guideline 2 - Problem relevance

“The objective [...] is to develop [...] solutions to important and relevant business problems” (Hevner et al. 2004). Taking an interpretivist-hermeneutic perspective (based on Klein and Myers 1999) one might ask:

- Principle of multiple interpretations: How do the different subjects that are involved in the situation interpret the problem situation?
- Principle of suspicion: Are different problem perceptions and definitions guided by biases or systematic distortions in the narratives of the participants?
- Principle of interaction between the researchers and the subjects: To what extent is the (research) problem situation socially constructed through the interaction between researchers and participants?
- Principle of contextualisation: To what extent is the problem grounded in the social and historical setting of the research case and to what extent are certain insights (not) generalisable?

Guideline 4 - Research contribution

“[Design science research ...] must provide a clear and verifiable contribution [...]” (Hevner et al. 2004). Related questions from an interpretivist-hermeneutic perspective (based on Klein and Myers 1999):

- Principle of dialogical reasoning: In how far did the particular piece of design research show certain sensitivity to possible contradictions between the theoretical preconceptions guiding the research and actual findings with subsequent cycles of revision?
- Principle of contextualisation: To what extent is the problem grounded in the social and historical setting of the research case and to what extent can specific contributions be considered as a ‘generalisable’ contribution?

Guideline 5 - Research rigour

Design science research “relies on the application of rigorous methods” (Hevner et al. 2004). Related questions from an interpretivist-hermeneutic perspective (based on Klein and Myers 1999):

- General: Which methods should be used in order to conduct and to evaluate design science research? What are the assumptions of these methods? Do certain evaluation methods have an inherent epistemological background? Here, for instance, the 2006 SJIS debate issue intensely discussed the philosophical assumptions of the Bunge-Wand-

Weber-Ontology. The question arises of in how far the assumptions of such evaluation methods match with the other philosophical assumptions made in the research process (Niehaves 2005).

Here, I did not attempt to fully solve the question of interpretivist design science research guidelines, but rather give a brief outline of how the perception of design science research guidelines varies according to an assumed epistemology, interpretivism in this case.

4 Conclusions

As I argued in the paper, design science research is not only a positivist domain, but also open to alternative epistemologies. Here, Iivari (2007) addresses the problem of epistemology in design science and differentiates three types of design knowledge. While descriptive knowledge contains a certain truth value, prescriptive and conceptual knowledge do not. At this point, I argued that the question of epistemology (how to achieve ‘true knowledge’) is though generally relevant to design science research practice, our daily work. Design science research, let it be of prescriptive intent, is embedded in a system of theoretical, descriptive, and empirical knowledge. Even if we just present a modelling grammar, in research practice, we still have to argue in how far we address a ‘relevant problem’, make a contribution, communicate our research etc. To sum up my arguments in a few points:

- A comprehensive integrated discussion of epistemology in information systems design science is not yet to be found. Instead, the discussion of design science research and its evaluation is often dominated by an implicit assumption of a positivist epistemology. Therefore, I very much welcome Iivari’s (2007) attempt to further discuss epistemological issues in design science. The differentiation of three types of design knowledge can be regarded a fruitful starting point.
- Design science research is not only a positivist domain, but is also open to alternative epistemologies. I provided arguments that taking an alternative epistemology has great impact on understanding design science research and on evaluating design science research results. I discussed this impact, but I did not intend to give any preference to a particular epistemological assumption. I consider it to be compulsory for the scientific discussion to analyse relevant implications, epistemological ones in this case, so that research evaluation can be conducted taking into account different (epistemological) worldviews. I would

suggest as further research to more comprehensively investigate the impact of alternative epistemologies on design science research and its evaluation. A pluralist environment in conducting design science research offers, to my opinion, great potential for solving relevant real world problems as well as the ‘internal’ problems that the IS discipline faces.

- I very much welcome Iivari’s (2007) assessment of the recent discussion in design science research: current contributions can make future design science research more rigorous and researchers more reflective over the research process. Taking again my German perspective, regardless of the great achievement of design-oriented research, there repeatedly exist severe methodological deficits (Heinrich 2005). Though one might argue that both streams of design-oriented research go after different mindsets, or at least have emerged in an environment of different mindsets, there exists great learning potential with regard to rigour AND relevance.

We need a constructive but also critical discussion of design science research to which Iivari (2007), in my view, makes a valuable contribution. A discussion which, on the one hand, takes into account the vast body of knowledge that exists in several IS research communities with a traditionally strong design-orientation. This includes, for instance, non-positivist and socio-technical design research. On the other hand, the recent discussion offers fruitful avenues to reflect, rethink, and improve traditional design research.

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