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# REFLECTING THE PAST DECADE OF ICIS, ECIS AND AMCIS PROCEEDINGS – A DESIGN SCIENCE PERSPECTIVE

*Research-in-Progress*

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## **Abstract**

*The methodological pluralism in IS research is topic of an ongoing discussion. Several claims have been made both in favor of methodological pluralism and against it. The debate focuses mainly the relationship between IS research methods (i.e. empirical/behavioural or constructional orientation) and the underlying IS research paradigms, especially positivism and interpretivism. As an integrative discipline Information System (IS) research has a multi-disciplinary and multi-national focus per definition. Further investigating that methodical pluralism we want to investigate how the methodical discussion effected the development of Design Science Research in the last decade. Therefore, we conducted a literature analysis of the proceedings of the three major IS conferences over the last decade. Our analysis of more than 7500 articles showed that the Design Science Research agenda indeed differs from the common IS research agenda in respect to the use of methods and seems to be more open for a multi-methodological research approach.*

**Keywords:** IS research, research methodology, design science research, literature review

## Introduction: The methodological pluralism in IS research

For several decades the term Information Systems (IS) summarized all kind of efforts that aim to modernize the private sector and the public administrations using modern information and communication technology (ICT). Next to the practical and political impact, IS links many different research fields and academic communities. Therefore, many distinct views on the term IS exist, each very much depending on the researcher's personal and cultural background and hence on the discourse history of the discipline the researcher is involved. Hence, IS research is not only exclusively between the economic and computer science research agenda. Different academic disciplines, such as organizational theory, political science, sociology, business administration, psychology, informatics etc. contribute to what is commonly known as IS research. The internationalization of research is conspicuous and in nearly all regional, national or international research communities IS research is conducted. Various research communities and academic disciplines contributing to IS are often shaped by specific research paradigms following their own research methodologies. Thus, the situation in IS research can be best described as a "methodological pluralism" (Mingers 2001; Mingers 2003). The wide spectrum comprises heterogeneous approaches which differ very substantially in their basic – especially epistemological – foundations and assumptions. These assumptions have a great impact on the validity, the reliability and also the "quality" (i.e. providing comprehensible and reproducible results) of research conclusions. The discussion about which criteria must be fulfilled by rigor research in this discipline consequently also has to consider epistemological issues. Therefore, the theoretical epistemological analysis of research methods applied in IS research – especially in the context of multi-methodological approaches – has great relevance for research practice.

Speaking about the IS discipline, we can observe a wide-ranging discussion of research paradigms. Emphasis has been placed on the discussion of epistemological paradigms, especially positivism and interpretivism (Becker et al. 2007; Benbasat et al. 2003; Frank 1998; Klein et al. 1999; Mingers 2001; Probert 2001; Vessey et al. 2002; Weber 1987). Here, a paradigm is understood as a distinct world view based on certain epistemological and ontological assumptions. However, the term paradigm is not only used to distinguish between particular epistemological positions. (Hevner et al. 2004) and (March et al. 1995) introduce two different paradigms in IS research: behavioural science research (BSR) and design science research (DSR). As described in table 1, the former is understood as a "problem understanding paradigm", the latter as a "problem solving paradigm". Hence, BSR and DSR can be epistemologically interpreted as two different phases of a problem-oriented research process, i.e. understanding and solving it.

	<b>Behavioural Science Research (BSR)</b>	<b>Design Science Research (DSR)</b>
<i>origin</i>	natural science	engineering, sciences of the artificial
<i>paradigm</i>	problem understanding paradigm	problem solving paradigm
<i>objective</i>	develop and justify theories which explain or predict organizational human phenomena surrounding the analysis, design, implementation, management, and use of information systems	create innovations that define ideas, practices, technical capabilities, and product through the analysis, design, implementation, management, and use of information systems
<i>object</i>	human-computer-interaction	IT artefact design

**Table 1: Behavioural and Design Science Research (Hevner et al. 2004)**

Consequently, the discussion of IS research paradigms is ambivalent, for instance, epistemology on the one hand and BSR/DSR as paradigms on the other hand. Consequently, the discussion of IS research diversity should incorporate such ambivalence. Since the different paradigms imply different research methods, this paper will try to find out which IS research methods have been used in the past ten years and whether we can observe any development. Focusing on the BSR/DSR paradigms this implies answering the following research questions:

1. Which research methods did the IS research agenda use in the past decade? As stated before we will discuss this question in the context of the ongoing discussion. Having a multi-disciplinary and multi-national focus

we try to find out to which extent the use of research methods in IS depends on regional factors and cultural backgrounds.

2. Does the DSR agenda need further differentiation? Arguments have been made both in favor and against methodological pluralism in general and DSR in particular. We suggest a framework for DSR and fill it with the reviews results.

The first question implies the differentiation of (Hevner et al. 2004) and (March et al. 1995) between empirical science research (problem understanding) and design science research (problem solving). For this purpose we conducted a literature review of the proceedings of three major IS conferences in the last 10 years. The detailed methodology is described in chapter 2. Chapter 3 presents the results. Chapter 4 interprets the literature review in the context of IS research paradigms and derives implications for future research in IS. The paper concludes with a summary of arguments and findings and an outlook to our research-in-progress. A full interpretation of the results and therefore the answer to the second question will not be provided in this paper. In order to answer the second question we will have to analyze the results in more detail. Therefore a theoretical framework is suggested in the subsequent chapter.

## **Research method**

### *Description of the approach*

In order to create a profile of the methods used in IS research the study thoroughly examined all papers in the conference proceedings of the International Conference on Information System (ICIS), Americas Conference on Information System (AMCIS) and the European Conference on Information System (ECIS) that have been published between the years 1999 and 2008. The authors carefully reviewed a total of more than 7500 research articles for capturing data on the research settings. As a first step we distinguished between categories of conference papers (i.e. BSR and DSR contributions) by explicitly or implicitly mentioning a research method. Such a research approach for the systematic classification of research published in a particular journal or conference is called a meta-study or longitudinal literature review. Since this approach has been previously successfully employed to profile a number of IS journals including the Information & Management (I&M) (Claver et al. 2000; Palvia et al. 2007), the Information Systems Journal (ISJ) (Avison et al. 2008) or the German IS-Journal Wirtschaftsinformatik (Becker et al. 2008; Heinrich 2005), we also utilized it in order to profile the conference proceedings.

In order to answer the second research question the empirical evidence resulting from the first research question gives a first clue. We believe however further theoretical distinction within the IS research is needed. Therefore we introduce the following categories:

- Build and Evaluate (Benbasat et al. 1999; March et al. 1995)
- Theories (Gregor et al. 2007) and Artifacts (Hevner et al. 2004)
- Positivistic, interpretive (Klein et al. 1999) and constructive (Iivari 1991)
- socio-technical IS and technical Computer Science (Alter 2008; Hevner et al. 2004)

These categories further elaborated the BSR and DSR distinction we introduced above. Our focus is to differ DSR in typical constructive design methods and make contributions of DSR public. This is tricky since only the rigor of methods distinguishes the design science researcher from the practice of building IT artifacts. Iivari (2007) states that a IT practitioner applying constructive design methods would consequently – though probably unintentionally – doing (Design Science) IS research. Nevertheless, having constructive research methods is essential for the identity of IS as a design science. This suggests two ways to identify the difference

- a) There are no constructive research methods. Building artifacts is a purely creative (unscientific) task. Instead the only difference is the evaluation. Design Science requires scientific evaluation of existing artifacts rather than building new ones.
- b) Define a rigorous approach for constructive research itself and use this to differentiate design science from invention in practice.

This differentiation implies further distinction – e.g. between Design Science Theory (building new theories) and the construction of new/relevant artifacts. One can also ask which underlying paradigm the researchers applies (e.g. Positivistic, interpretive or constructive). An approach we strongly support is – before differing DSR in a) and b) – asking whether we speak about socio-technical IS or purely technical Computer Science.

### ***Assumptions and selection criteria***

The conferences ICIS, ECIS and AMCIS were selected for multiple reasons in order to answer our research questions. Wanting to know which research methods are used in IS, we considered the three major IS conferences a solid base to make that comparison. We assume that the conference provides comparable standards of the contributions (e.g. by quality, originality, research rigor etc.). Of course we are well aware that these standards vary between the year the conference is held (e.g. the focus changes), the size of the conference (e.g. AMCIS 2000 was about twice as big as in other years) the location of the conference (especially ICIS travels around the world) and between the conferences itself. Still, since we are interested in international comparisons as well, we need different sources in different regions that provide approximately the same standards of work. We believe ICIS, ECIS and AMCIS to fulfill these criteria in a good way. Having a European, an American and an International conference should provide a good set of comparable data for our investigation. Of course, there are other sources for such a comparison – namely top IS Journals. In the future we plan to extend the investigation to major IS journals. However, we intend to use the same logic of selection, i.e.: Take journals that provide the same quality standards (e.g. “Basket of 8” (C. Saunders et al. 2006)), select three journals that are distinct by region (America, Europe and International) and apply the same criteria in the meta-study.

Searching the conference proceedings was conducted in a semi-automated manner. We selected several keywords indicating either BSR or DSR and used them for a full-text search in the conference proceedings. Afterwards we reviewed the results manually in order to verify the search. Typical keywords for selecting BSR are for instance “empirical, questionnaire, quantitative or survey”. Paper with a DSR orientated setup can usually be identified by looking for keywords like “computer science, design research, design science, design theory, IS development, prototype/prototyping, software development”. The keywords have been picked from previous literature reviews (Becker et al. 2008; Chen et al. 2004) and presented for discussion at monthly colloquium in our department. Two subject matter experts were additionally invited to join that session.

The full text search however came up with a far bigger amount of paper belonging to each category since such an automatic scan by keywords included many papers that actually do not belong in either of these groups. For example Prof. John Doe of the department of “business administration and quantitative methods” does not always use quantitative methods in his research. We also found the keyword “computer science” quite often in the biographies and the phrase “this development” in the text which had, of course, mostly little relevance for “IS development” (without “th”). Hence, our search results had to be reviewed manually. We used a full text search tool that supports regular expressions and a (pre-) view into the actual document. Using the regular expressions we could eliminate papers counted twice - for instance if a paper uses multiple keywords like “software development” and “prototype”. Overlooking the documents in the text preview of our results we immediately saw in which context the (highlighted) keyword was used. Hence, we could finally assign each paper to a group.

But while grouping the papers into BSR and DSR, we came along a few issues assigning the adequate research method within the DSR group. Especially differing between theories and artifacts as well as socio-technical and purely technical papers mostly requires to read the whole paper. Still then some papers fit into more than one of our categories and we had a lot of discussion how to categorize them. This does not get any easier if the authors did not explicitly mention the research approach they used. Our guiding principle was the identification of keywords; e.g. if we found the keyword “prototype” we checked whether an actual prototype was built or an existing prototype was used in a design orientated context – i.e. verify a certain architecture/approach etc. If the authors did not use a single of our keywords, their paper is not in our list. If they used one of our keywords but did not refer to it as their research approach, we looked into the paper in even more detail.

### Limitations of our approach

As carefully as this literature review may have been conducted we are however aware of its limitations: First one must note that a literature review always is of subjective nature to a certain point. Second we were simply not able to read every paper in full<sup>1</sup>. Consequently we could not categorize the paper with absolute certainty. Hence, we can not state to have found overview of all the research methods used in the last ten years in the selected IS conferences. We can however conclude with some confidence that we listed every paper in which the author referred directly or indirectly to a research method that we were able to identify using our keywords. The keywords are our attempted to make this literature review more objective. To eliminate cases of human error as much as possible, each search result of a regular expression (e.g. resulting paper list of search terms for BSR) was reviewed by at least two people independently from each other. In case of any different categorization or any doubt, the assignment of the paper was discussed in a bigger group.

We are aware that distinguishing only between the two groups of BSR and DSR is per se problematic. Since we are investigating possible ways for an intensive international exchange among the various IS research communities, we consider this coarse-grained distinction as a good starting point for our research. Differences in the characteristic features of the various IS communities and explaining the diverse paths of development they took have been already described (Frank et al. 2008). We intended to quantify these observations as a first step. Using only two categories of research methods however leaves big room for interpretation within the third group of “other” research methods. Among this group we found a variety of actually very good and fundamental research done, grounded for example in organizational theory or social systems theory. In total numbers however this is a relatively small amount of papers.

## Results of literature review

### Research methods at major IS conferences

Before investigating the DSR agenda in more detail, we want to know the overall relation between research methods at the most important IS conferences. This step is needed to answer our first question which research paradigm is dominant in the IS research agenda and whether there is a regional of cultural influence. Therefore, we analyze the amount of papers that follow either the BSR or the DSR orientated agenda. The resulting statistic will serve as a benchmark in order to identify developments and possible trends in the IS research.

	ICIS 99	ICIS 00	ICIS 01	ICIS 02	ICIS 03	ICIS 04	ICIS 05	ICIS 06	ICIS 07	ICIS 08	SUM Σ	AVG %
Σ ALL PAPER	81	94	81	94	107	89	86	122	159	211	<b>1124</b>	
Behavioural	63	71	64	72	78	68	59	66	105	133	<b>779</b>	69%
Design Science	8	13	10	13	21	19	26	54	40	73	<b>277</b>	25%
other	10	8	7	9	8	2	3	2	14	5	<b>68</b>	6%

**Table 2: Relation between research methods at ICIS**

Table 2 indicates the relation between the research paradigms of the papers presented at the ICIS conferences in the last decade. First it should be stated that the presence of our two investigated paradigms (BSR and DSR) is very high. In average 69% of contributions used a BSR orientated and 25% a DSR orientated outlet in the last ten years. Thus, the fraction of the third category (other methods) is only about 6% strong. Most of the presented papers used an empirical research method; almost 80% from 1999 till 2004 and still more than 2/3rd of the paper presented in the years 2005-2008. Yet, in the most recent years there is a trend observable towards presenting/accepting more

<sup>1</sup> In order to answer our second research question and categorize the DSR related work in more detail we have to read at least all the papers identified as DSR. Actually this is the reason why the paper is still presented as „research-in-progress“.

DSR at the ICIS. Starting with only 10% in 1999, today in average 1/3rd of all the papers in the ICIS proceedings 2005-2008 used implicitly or referred explicitly to a DSR method.

	AMCIS 99	AMCIS 00	AMCIS 01	AMCIS 02	AMCIS 03	AMCIS 04	AMCIS 05	AMCIS 06	AMCIS 07	AMCIS 08	SUM $\Sigma$	AVG %
$\Sigma$ ALL PAPER	358	818	440	360	263	579	522	550	512	406	<b>4808</b>	
Behavioural	196	557	308	268	202	457	366	442	360	300	<b>3456</b>	72%
Design Science	18	48	28	24	28	41	38	68	67	50	<b>410</b>	9%
other	94	178	62	68	32	81	118	45	27	44	<b>749</b>	16%

**Table 3: Relation between research methods at AMCIS**

The trend towards more DSR in IS research can however not be observed at the AMCIS – if so only a marginal one. Table 3, which shows the relation between research methods of papers presented at the AMCIS conferences, does not show much of such a development. The leading research methods are (and with 72% in average always have been in the last 10 years) empirical based. One can however notice a sharp drop in the third category. While in 1999 still about a third of the paper did not use (or at least did not refer to) either a behavioural or a design science orientated research method, today only every tenth paper belongs to this group. However both investigated research paradigms BSR and DSR seem to benefit equally from this trend towards more explicit rigor at AMCIS which seem to make the fraction DSR paper slightly bigger in recent years.

	* ECIS 99	ECIS 00	ECIS 01	ECIS 02	ECIS 03	ECIS 04	ECIS 05	ECIS 06	ECIS 07	ECIS 08	SUM $\Sigma$	AVG %
$\Sigma$ ALL PAPER	82	205	127	157	185	179	162	210	197	222	<b>1726</b>	
Behavioural	-	104	68	89	108	112	94	131	118	132	<b>956</b>	55%
Design Science	-	79	50	60	67	60	62	73	74	83	<b>608</b>	35%
other	-	22	9	8	10	7	6	6	5	7	<b>80</b>	5%

**Table 4: Relation between research methods at ECIS\***

In general, our results from the AMCIS and ECIS proceedings show once again that different academic disciplines and research communities tend to adopt distinct research methodologies and approaches. As previous studies (Chen et al. 2004) investigating European and US American IS Journals) showed on a methodological level, quantitative methods clearly dominate the (US) American IS research culture while the research published in European IS journals applies about 40% qualitative methods. Our stats for the ECIS (depicted in Table 4) confirm these numbers in almost the exact sum.



**Figure 1: ICIS holds the middle ground in applying BSR or DSR**

Comparing the numbers by region directly in a single graph (Figure 1) it is noticeable that the overall percentage of the ICIS lies (except for one outbreak of 45% qualitative research paper at ICIS 2006) between ECIS and AMCIS numbers. We can therefore conclude that ICIS – initially shaped by North-American IS researchers – more and more becomes an international platform to exchange research results among the various IS research communities. This interpretation is supported by the trend towards more DSR at ICIS over the last years. The results for the regional conferences ECIS and AMCIS are as one would have suspected and as many previous articles indicated: DSR is mostly applied in Europe; BSR is the dominant research paradigm in America (Frank et al. 2008).

## Tentative Conclusion and Outlook

Given the results of our first literature analysis we can state that IS has a multi-methodology research agenda since none of the paradigms is dominant in the IS discipline. In total numbers more BSR is conducted IS research. This however only holds true if we look at the overall results. A strong cultural and hence political background of IS research can be identified if the different regions are taken into account. At this points, other types of categorization seem interesting to observe – e.g. differ by conference tracks/specific research fields or assign research methods. For instance, we plan analyzing E-Government related paper at the three major IS conferences. Since E-Government is a (relatively) novel field in the IS research agenda we are interested in how the results differ from the overall results concerning the use of a multi-methodological research agenda, the influence of cultural and political backgrounds or the relation between BSR and DSR in general – i.e. the relation between problem-understanding- and problem-solving-paradigm in a novel research field. Intuitively we would expect the level of interaction between the paradigms to be higher in young areas of research.

The (still missing) full interpretation of the results leads to our second research question whether the DSR agenda needs further differentiation. As stated before we are interested in creating interaction between the different IS paradigms and IS research in general. We will distinguish and find similarities between theories and artifacts, building and evaluating IS prototypes, positivistic and interpretive contributions as well as socio-technical and purely technical papers. It is furthermore planned to include major IS journal into our comparison.

We expect the results of our work to contribute to the epistemological foundation of DSR and to further formalize the relation between BSR and DSR. We believe that international IS researchers must be provides a theoretical foundation on which they can exchange their results – referring to similar underlying assumptions. These topics are of high actuality and impact for the IS community are intensively discussed at the International Conference of Information Systems. Therefore we do not only consider the ICIS to be an adequate forum to present our research approach. We would like to take the opportunity to invite international researches to give us critical feedback on our approach. Active participation in the research is also more than welcome.



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