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Carl Stolze
Dennis Janßen
Oliver Thomas

Sustainability as a Topic of IS Research: Reviewing a Decade of Literature

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Prof. Dr. Oliver Thomas
Universität Osnabrück
Fachgebiet Informationsmanagement und Wirtschaftsinformatik
Katharinenstraße 3, 49074 Osnabrück
Telefon: 0541/969–4810, Fax: –4840
E-Mail: oliver.thomas@uni-osnabrueck.de
Internet: http://www.imwi.uos.de/

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Living Lab Business Process Management e.V.
Universität Osnabrück
Katharinenstraße 3
49074 Osnabrück
www.living-lab-bpm.de

Sustainability as a Topic of IS Research: Reviewing a Decade of Literature

Carl Stolze, Dennis Janßen, Oliver Thomas

Chair in Information Management and Information Systems,
University of Osnabrück
Katharinenstraße 3, 49074 Osnabrück (Germany)
{carl.stolze|dejansse|oliver.thomas}@uni-osnabrueck.de
http://www.imwi.uos.de/

Sustainability becomes more and more important for business and research alike. Whilst the trend might be in full swing, we would like to reflect on the published research results in the IS field's top research outlets. We do so in form of a structured literature review on the AIS Senior Scholar's Basket of Six (B6) plus the primarily German-language journal Wirtschaftsinformatik (WI). We chose those 7 outlets to reflect on the different research streams and traditions within the global IS discipline as well. In this paper we present the first results from our analysis and outline some preliminary implications.[1]

1 Motivation

For the year 2050 the global human population is expected to have reached 9 billion. Thereby questions of sustainability become more important than ever for businesses around the globe. Also this development offers opportunities for those companies who anticipate or drive the change towards sustainability in their respective industries (WBCSD 2010). Although the importance of sustainability might be assessed differently between industries, the United Nations Global Compact CEO Survey found sustainability issues being seen as an important factor for future success across all industries (Lacy et al. 2010). Another study supports this: sustainability is said to become one of the top five concerns of CEOs by 2015 (Gartner Inc. 2011).

Having this in mind, it becomes evident that information and communication technology (ICT) as a – if not the – cross-sectional technology has to do its part for answering today's and tomorrow's sustainability questions (Elliot 2011). It is estimated that ICT could help to reduce carbon dioxide emissions up to 15% by 2020 in a conservative scenario. The economic impact of cost savings through smarter "things", such as smart grids, smart buildings or smart logistics, alone is estimated as high as 600 billion Euro (nearly 800b US dollars) (The Climate Group 2008). But so far the contribution of the information systems (IS) research community has been described as weak (Jenkin et al. 2011) despite many publications.

Within this paper we would like to reflect on the published research results in the IS field's top research outlets. We do so in form of a structured literature review on the *AIS Senior Scholar's Basket of Six* (B6) plus the primarily German-language journal *Wirt-*

[1] A previous version of this paper has been published on SSRN and is available at http://ssrn.com/abstract=2030821 or http://dx.doi.org/10.2139/ssrn.2030821

schaftsinformatik (WI). We chose these outlets also to reflect on the different research streams and traditions within the global IS discipline.

Having pointed out our motivation to investigate the topic and briefly described already our way to do so, we provide some background information in the next chapter. Afterwards we dive into the methodological considerations and the exact method employed for our literature search. Following, initial results are presented before we close the paper with a preliminary discussion and our future research plan.

2 Background

2.1 Sustainability and IT

The so-called Brundtlandt report by the WCED made the general public aware of the topic of sustainability. Whilst that report itself focuses on sustainable development and not sustainability as such, its statements become the very foundation for the concept of sustainability in later years (El-Gayar and Fritz 2006). Sustainable development has been defined since then as "*development that meets the needs of the present without compromising the ability of future generations to meet their own needs*" (WCED 1987).

Later on, the topic was also specifically discussed within the ICT community. Practitioners and academics alike started to talk mainly about questions related to energy efficiency under the umbrella terms Green IT or Green ICT (Ozturk et al. 2011). Only recently, discussions became broader to cover questions of resource efficiency of IT itself and through IT as a means to an end (Boehm et al. 2011; Jenkin et al. 2011). At the same time, businesses around the world started to integrate sustainability considerations into their very core rather than seeing it merely as an add-on (Lacy et al. 2010). More specifically approaches to integrate sustainability have been discussed for IT management (Schmidt et al. 2009), IT management training programs (Stolze et al. 2011) and business process management (Nowak et al. 2011). Even this short and far from exhaustive enumeration should outline how many relevant challenges for researchers could be tackled at the crossroads of sustainability, business and information systems (Melville 2010).

2.2 Information Systems – Two Approaches to Research

IS research follows two big streams in general: a more behavioristic one and one that can be best described as design or engineering-oriented (Kuechler and Vaishnavi 2008). The more descriptive, behavioristic approach has been dominant in North American IS research for most of its time. The design-oriented and often engineering-based approach on the other hand is seen as typical for the German IS research landscape (Frank 2006; Österle et al. 2011). At first, design science was conceptualized as being focused on the IT artifact per-se (Hevner et al. 2004). Recent approaches on design science go specifically beyond that and include socio-technical aspects (Carlsson et al. 2010). This might bring the two big research streams of behaviorism and design closer together again. Also design science became more popular in North American IS research. This trend is reflected by the fact that MIS Quarterly not only started accepting design science research articles (e.g. Hevner et al. 2004), but even dedicated a whole issue to it (Volume 32, Issue 4). Despite these developments, there are still different traditions with their underlying methodologies and assumptions in IS research.

3 Methodological Considerations and Examining the Literature

3.1 Choosing Method and Procedure

A systematized examination of published literature is – in our view – a suitable way to lay the ground for a meaningful reflection on research regarding sustainability in the IS discipline. Therefore we choose to conduct a structured literature review to see how the topic of sustainability has been discussed by IS researchers within the last decade. To make our literature search process as transparent as it should be (vom Brocke et al. 2009), we explain how we defined scope and search strategy in the following.

The scope of a literature review can be defined by subject, period covered and publication outlets searched as boundaries (Webster and Watson 2002). The subject of our review is sustainability. As outlined before, questions in this area have also been discussed under the term Green IT. Therefore, our first search terms are 'sustainability' and 'green IT'. We decided to add 'green IS' as a search term, because some authors use it to distinguish between the development and use of information systems for sustainability purposes ('green IS') and more energy consumption-concerned research ('green IT') (Jenkin et al. 2011). For the time period covered in our research we chose the decade from 2000 till mid–2011. Thereby trends or even research fashion should become visible (see also the research on fashion waves in IS research by Baskerville and Myers 2009).

A difficult decision is the publishing outlets to search for. On the one hand, the more outlets are included, the more published research could be found. On the other hand, a focus on the leading journals facilitates the finding of contributions of a higher quality as well as the major ones in a field (Webster and Watson 2002). In this paper we decided to focus on the top tier international journals as found in the *AIS Senior Scholar's Basket of Six* (B6). We added the German-language journal *Wirtschaftsinformatik* (WI) to better reflect the two previously mentioned methodological traditions in IS research.

3.2 Conducting the Literature Search

To ensure an exhaustive as possible result when conducting the literature search, we searched in as many fields or "bites" of information as possible – usually title, abstract and full text – whilst ensuring to stay in the boundaries chosen before. Also potentially important is which online database is employed for the search. Three out of the seven journals could be searched through vie EBSCOhost, whilst for the others we used their websites directly. Table 1 summarizes the resulting search strategy's implementation.

Please note, the WI was partially searched via SpringerLink and partially via its own homepage. This is due to the fact that SpringerLink only started indexing the WI in 2006.

The search term *sustainability* yielded 109 articles published in the inspected journals within the selected period of time. Five times less articles could be identified by its German translation *Nachhaltigkeit* – the second most successful term. Third came *Green IT* with 6 articles and eventually *Green IS* with 3 articles.

Then we analyzed how many articles could be found through multiple search terms. Surprisingly, this number is relatively small: Only seven articles could be identified through more than one term. One article even contained all four. One article was accessible through three terms (S*ustainability*, *Green IT*, *Green IS*). Five articles could be reached through two terms: two each when searching for *Green IT* and *Nachhaltigkeit* or *Sustainability* and *Nachhaltigkeit* respectively, one article when looking for S*ustainability* and *Green IS*. Subsequently, the number of mutual articles can be calculated as follows:

number of articles: $138 - 1 \cdot 3 - 1 \cdot 2 - 5 \cdot 1 = 128$.

Therefore, 128 articles are included into further investigation. What can be noted at this stage already: out of the 7 articles found through multiple terms, 5 included the German term *Nachhaltigkeit*.

Table 1. Implemented Search Strategy

Journal	*Database*	*Search terms*	*Search fields*	*Coverage*
European Journals of Information Systems (EJIS)	Palgrave Macmillian	'sustainability', 'green IT', 'green IS'	'keywords', 'title', 'full text'	2000–2011
Information Systems Journal (ISJ)	EBSCOhost	'sustainability', 'green IT', 'green IS'	'all text', 'title'	2000–2011
Information Systems Research (ISR)	Informs	'sustainability', 'green IT', 'green IS'	'text', 'abstract', 'title'	2000–2011
Journal of Management Information Systems (JMIS)	EBSCOhost	'sustainability', 'green IT', 'green IS'	'all text', 'title'	2000–2011
Journal of the Association for Information Systems (JAIS)	EBSCOhost	'sustainability', 'green IT', 'green IS'	'all text', 'title'	2000–2011
Management Information Systems Quarterly (MISQ)	Journal Homepage	'sustainability', 'green IT', 'green IS'	'title', 'abstract'	2000–2011
Wirtschaftsinformatik (WI)	SpringerLink	'sustainability', 'green IT', 'green IS', 'Nachhaltigkeit'	'search token' (one field for all information)	2006–2011
Wirtschaftsinformatik (WI)	Journal Homepage	'sustainability', 'green IT', 'green IS', 'Nachhaltigkeit'	'search token' (one field for all information)	2000–2005

Table 2. Found Articles by Journal and Search Term

Journal	*'Sustainability'*	*'Green IT'*	*'Green IS'*	*'Nachhaltigkeit'*	*Total*
European Journals of Information Systems (EJIS)	19	0	0	0	19
Information Systems Journal (ISJ)	6	0	0	0	6
Information Systems Research (ISR)	10	0	0	0	10
Journal of Management Information Systems (JMIS)	27	1	2	0	30
Journal of the Association for Information Systems (JAIS)	23	1	0	0	24
Management Information Systems Quarterly (MISQ)	18	0	0	0	18
Wirtschaftsinformatik (WI)	6	4	1	20	31
Total	*109*	*6*	*3*	*20*	*138*

4 Sustainability in IS Research

4.1 Author analysis

As a first step towards a meaningful reflection about sustainability in IS research, we analyzed the authorship of the articles found. We found in total 315 authorships for the 128 identified articles. As a result, 2.46 persons on average have authored one article. Thereby, we are certain that research on sustainability in the IS field is largely a joint effort of multiple persons.

It is often claimed that women are under-represented in IT and related areas (McKinney et al. 2008). To determine the share of female authorships, we applied a two-step procedure: First, we identified most likely female authors based on the first name. This was done having in mind that certain names might be used differently across cultures. Second, we checked when in doubt authors' academic web-sites or other reliable online sources, e.g. profiles on academic sites such as mendeley.com or academia.edu as well as professional profiles on networks like LinkedIn. Eventually, we found only 58 of the 315 authorships are assigned to female researchers. This share of 18.41 % confirms the often anecdotally assumed underrepresentation of women in IS research.

In the following, we looked if there are any dominating authors in the field. In order to do so, we unified the spelling of author names to an initial plus surname style rather than a combination of spelled and abbreviated parts. After counting the number of articles per author, we found only four authors to have been involved in three articles. All others contributed to one or two articles. Therefore, we did not found any dominating author in terms of articles published. But unlike a citation analysis, e.g. (Xiao et al. 2011), this analysis does not investigate the impact of an article or its author.

4.2 A Matter of Time

To understand the development of sustainability as a research trend as well as potential differences between the journals, we counted how many articles have been found per journal and year. This number helps to understand whether a journal was at the forefront of sustainability-related IS research or rather following on the topic. For this analysis we filtered out duplicate articles and drew a line chart to be able to see trends and changes. As depicted in Figure 1, depending on the year journals seem to be accepting a different number of articles regarding sustainability.

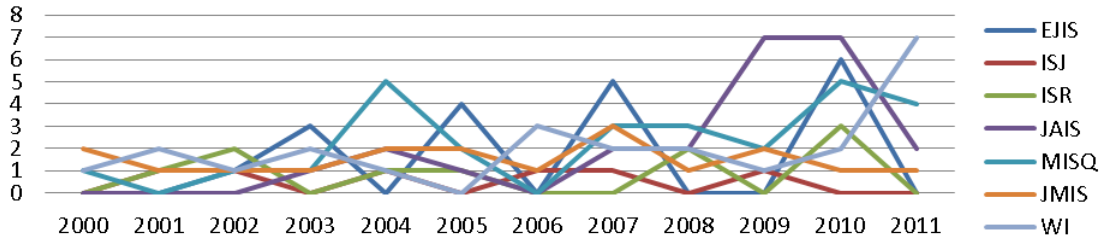

Figure 1. Number of Articles per Year and Journal without Duplicates

Taking a closer look, it became quite obvious that throughout the years only a few or no articles about sustainability had been accepted into ISJ. The opposite is JAIS, which peaked in 2009 and 2010, apparently having identified sustainability as one of the current-

ly highly relevant research topics. Even more obvious is the trend pattern for WI. It peaks in 2011 with 7 articles already published in only the first half of the year. The other outlets are – maybe already – accepting fewer articles on the topic. Interesting is also MISQ: It constantly accepts a relatively high number of articles on the topic. The only exception is the year 2006: Besides WI, in that year only very few articles about sustainability got accepted into one of the journals investigated.

Having analyzed the absolute number of articles in different journals, the question arises if there is also a difference in relative terms: The total number of articles per journal differs. Therefore, we counted how many articles had been published in the period of time we covered within each journal. This was the divisor to the number of articles on sustainability to calculate the relative amount of articles incorporating our search terms per journal (Table 3).

Table 3. Relative Amount of Articles Related to Sustainability

Journal	*Relative Amount*
European Journals of Information Systems (EJIS)	0.04
Information Systems Journal (ISJ)	0.02
Information Systems Research (ISR)	0.03
Wirtschaftsinformatik (WI)	0.07
Journal of Management Information Systems (JMIS)	0.09
Journal of the Association for Information Systems (JAIS)	0.09
Management Information Systems Quarterly (MISQ)	0.04

We found quite a big differences between the journals. The lowest number can be found in ISJ (0.02) whereas JMIS and JAIS publish (relatively) 4.5 times more articles on sustainability. MISQ and EJIS both stay in the middle with a quota of 0.04, whilst the German WI journal accepted 7 out of 100 articles to cover some aspects of sustainability. Summarizing, it can be said that it is more likely for an accepted article to cover sustainability in JMIS and CAIS than in ISJ or ISR.

4.3 Methods Used for Sustainability Research in IS

Before choosing a publication outlet for new knowledge, it needs to be created. The choice of a research method as the way to gain knowledge is particularly difficult in a discipline such as IS research, because it is multidisciplinary and thereby rich in methods by nature (Becker and Niehaves 2007). Research methods can be distinguished by paradigm or methodological features such as empirical versus non-empirical or quantitative versus qualitative (Chen and Hirschheim 2004).

In a method-rich discipline as IS research, different trends or patterns regarding the use of research methods might occur. There is said to be a difference between US and European journals regarding the use of qualitative or quantitative methods in their articles (Becker and Niehaves 2007; Chen and Hirschheim 2004). Furthermore, there has been a lively discussion in the German IS community about differences in underlying basic assumptions as well as about different methodological approaches compared to the global IS research community. In particular, a more design-oriented approach is said to be taken compared to a more behavioristic one (Wilde and Hess 2007; Österle et al. 2011).

Having this in mind, we analyzed which methods have been employed in the 128 articles found. Because of the existing plethora of different research methods and approaches,

an analysis only makes sense when summarizing methods under a finite number of umbrella terms to enable comparison between outlets. We do so by assigning each found article to one of the following 11 different methods as umbrella terms (Wilde and Hess 2007): argumentative-deductive analysis, simulation, reference modelling, action research, prototyping, case study, quantitative cross-section analysis, experiment (lab/field), formal-deductive analysis, conceptual-deductive analysis, qualitative cross-section analysis. These methods include qualitative and quantitative as well as design-oriented and behavioristic approaches. For each of the 128 articles the predominant or closest matching research method was counted to identify the number of articles per research method and journal (Table 4).

Based on these numbers it can be concluded that case studies and quantitative cross-section analysis are the most favored behavioristic methods. Among the design-oriented ones the argumentative-deductive analysis is the most used one and also the most used method in total. Besides, reference modelling as a design-oriented method is also popular.

Table 4. Identified Number of Articles per Research Method and Journal

			Journal	*EJIS*	*ISJ*	*ISR*	*JAIS*	*JMIS*	*MISQ*	*WI*	*Total*
#articles per identified research method	Behavioristic	Qualitative	Case Study	5	1	0	2	1	5	2	16
			Qualitative cross-section analysis	2	0	0	2	0	0	0	4
		Quantitative	Experiment (lab/field)	1	0	0	0	1	1	0	3
			Quantitative cross-section analysis	2	0	4	4	8	4	3	25
	Design-oriented		Action research	0	0	0	0	0	2	1	3
		Qualitative	Argumentative-deductive analysis	4	3	3	10	4	8	12	44
			Prototyping	0	0	0	1	0	0	3	4
		Both	Conceptual-deductive analysis	0	0	0	1	0	3	0	4
			Formal-deductive analysis	0	0	1	1	2	1	1	6
		Quantitative	Reference modelling	5	2	2	3	1	3	2	18
			Simulation	0	0	0	0	1	0	0	1
Total				*19*	*6*	*10*	*24*	*18*	*27*	*24*	*128*

But those raw numbers do not allow a direct comparison of the popularity of a certain method within a certain journal in the context of sustainability research. For this the relative number of articles using a certain method per journal needs to be looked at (Figure 2).

This comparison shows interesting results: First, most journals accept articles based on behavioristic as well as design-oriented approaches. Second, the share of design-oriented articles in all journals is relatively high. Leaving ISJ due to the small total number of articles found aside, articles grounded on behavioristic methods are only in the majority (small one indeed) for JMIS. Therefore the question arises if the real difference is not between a design-oriented or behavioristic take on research, but on qualitative versus quantitative. Adding up the numbers shows more pronounced differences (Table 5).

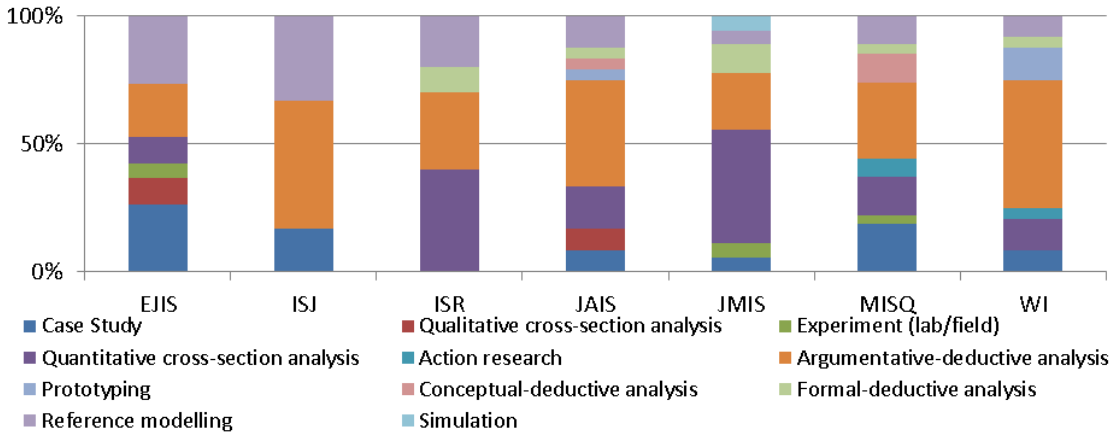

Figure 2. Methods Used in Sustainability Research (Fraction per Journal)

The two journals with the strongest focus on quantitative methods in sustainability research are JMIS and ISR. On the other hand, WI is clearly biased towards qualitative approaches, to a lesser extent JAIS as well (results for ISJ should be handled with care due to the small number). EJIS and MISQ, which are sometimes seen as the flagship outlets of the American or the European IS community respectively, are relatively balanced with regard to qualitative or quantitative methodological grounding.

Table 5. Distribution between Qualitative and Quantitative Methods per Journal

	EJIS	*ISJ*	*ISR*	*JAIS*	*JMIS*	*MISQ*	*WI*
Indifferent	0%	0%	0%	4%	0%	11%	0%
Qualitative	58%	67%	30%	63%	28%	56%	75%
Quantitative	42%	33%	70%	33%	72%	33%	25%

5 Discussion of Limitations and Results

Having looked at where who when published using which method to gain knowledge, we sum up our (preliminary) results and discuss first potential implications from our findings. First, it can be noted that research on sustainability has found a place within IS research. Nonetheless there are still many challenges to tackle for researchers and the discipline's contribution has been seen as not matching its potential (Elliot 2011; Jenkin et al. 2011; Watson et al. 2010).

We chose to conduct a literature search focused only on the global top journals from the AIS Basket of Six and added the WI for a different perspective. Even in this small sample some journals seem to be accepting research regarding sustainability more likely than others. It might be possible that other interesting and highly relevant research on the topic has been published in other journals, in conference proceedings or in working papers. Another limitation might be seen in the fact that we analyzed only how many articles single authors got accepted into the outlets looked at. But we did not look at the impact of an article through a citation analysis. So there might be thought leaders but we did not identify them.

Nonetheless our analysis of 128 identified articles yielded already some interesting results:

1. Many authors seem to distinguish between sustainability as a concept and Green IT/IS. Therefore only very few articles could be found with multiple search terms. The exception is the WI where 'green terms' are used quite often with sustainability respectively its German translation.
2. Sustainability is a trending topic and publication numbers are on much higher levels than a decade ago. Furthermore, the WI seems to have tackled the topic only recently with full intensity, whereas other journals might have already peaked. Nonetheless the number of articles accepted even in the first half of 2011 is significantly higher than in 2000.
3. Methodological pluralism as a constituting element of the IS discipline is reflected in the research on sustainability. All kinds of research methods have been found in the identified articles.
4. Articles based on behavioristic or design-oriented methods got accepted across all journals. Therefore, methodological preferences between journals are not about behavioristic or design-oriented methods. The difference is rather between qualitative or quantitative methods. In the end the difference is bigger between journals than geographically defined or self-declared sub-communities of the global IS community.

In the further course of our research on sustainability in the IS discipline we plan to work on these points: First, we broaden our search in matter of outlets. Aside the top journals we will also include the major global IS conferences such as ICIS, AMCIS, ECIS, PACIS as well as publications by the AIS' SIG Green. Second, besides an analysis of research methods employed we are going to dive deeper into content by identifying the major conceptualizations and approaches presented. Furthermore, the analysis of differences in research methods has caught our attention and will be part of further discussions.

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Living Lab Business Process Management e.V.
Universität Osnabrück
Katharinenstraße 3
49074 Osnabrück
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