

*Explaining and Distinguishing Scientific Impact in Information
Systems Research:
A Study of Review Articles and Design Science Research*

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Dissertation

**Explaining and Distinguishing Scientific Impact in Information Systems Research:
A Study of Review Articles and Design Science Research**

submitted by
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Abstract

Since its inception, the Information Systems discipline has been striving to develop impactful papers that contribute to cumulative knowledge development. Yet, there is a surprising lack of insights on how scientific impact can be accomplished and to which extent this impact represents a substantial engagement with, and extension of the knowledge contributions of the original papers. Especially for review articles and design science research, there are both competing conceptions of what makes these papers impactful and a lack of empirical evidence that would inform this debate. Furthermore, there is a latent skepticism as to whether this sometimes staggering impact of review articles actually represents knowledge development. In a similar way, it is unclear how and to which extent design science research has stimulated meaningful, cumulative knowledge development in information systems. The goal of this thesis is therefore to (1) explain and to (2) distinguish the scientific impact of review articles and design science research. Specifically, the first goal considers overall scientific impact as the dependent variable whose association with antecedent factors is analyzed by regression methodologies. The second goal zooms in on the concept of scientific impact and considers it as a relation between citing and cited papers that is explored through methodologies of manual content analysis and machine-learning classification.

With Paper 1, I develop the foundation of knowledge development through review articles by crystallizing their contributions and aligning them with their underlying knowledge conversion processes in an overarching framework. This framework is based on the abstraction and codification of knowledge and thereby integrates two essential dimensions of knowledge development. Overall, the foundation developed in the first paper informs the underlying conception of knowledge development of both review articles and citing papers.

Addressing the first goal, Papers 2 and 3 develop and test scientometric impact models explaining the scientific impact of review articles and design science research, respectively. Beyond common control variables related to the journal and author level, they offer distinct insights for each type of paper. For review articles, I identify strong effects related to methodological transparency and the development of a research agenda, which vary depending on the type of review. For design science research, I show that theorization and novelty drive scientific impact.

Concerning the second goal, Papers 4 and 5 distinguish different types of scientific impact of review articles and design science research, respectively. To analyze the different types of impact that review articles have on their overwhelming number of citing papers, I develop machine learning classifiers. Specifically, I distinguish ideational impact, which corresponds to a substantial engagement with and development of the knowledge contributions of the review article, from perfunctory impact, which corresponds to more trivial connections to the review article. In a similar, though not automated way, I analyze the types of impact of information systems design theories, a particular type of design science research. These analyses primarily focus on whether follow-up research tests and extends these theories. Based on our content analysis, I identify an alarming paucity of follow-up research in this area and develop specific guidelines for the design science community to address this challenge.

The thesis concludes with an overview of the research contributions, implications for research practice, future research opportunities, and final remarks.

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List of Abbreviations

AIS	Association for Information Systems
AUC	Area under the curve
BVIT	Business value of information technology
CA	Citing article
DREPT	Design relevant/explanatory predictive theory
DS	Design science
DSR	Design science research
DV	Dependent variable
EKP	Emergent knowledge process
FN	False negative
FP	False positive
GLM	Generalized linear model
GVIF	Generalized variance inflation factor
IS	Information Systems
ISDT	Information systems design theory
ISJOUR	Information Systems journals
IT	Information technology
KM	Knowledge management
LSA	Latent semantic analysis
NLP	Natural language processing
POS	Part-of-speech
RA	Review article
RBV	Resource-based view
ROC	Receiver operating characteristic
SD	Standard deviation
SVM	Support-vector machine
TN	True negative
TP	True positive
VIF	Variance inflation factor

Introduction

Scientific impact is considered to distinguish research output across many scientific disciplines. As Sternberg and Gordeeva (1996, p.69) note:

“As both students and professionals, all of us read articles that stay with us for the rest of our lives; other articles are forgotten (at least from active memory!) moments after being read. Similarly, certain articles stay with the field and continue to be influential years after they are published, whereas other articles seem to disappear into thin air, and seem to have virtually no impact at all.”

In this context, the purpose of citations, the dominant measure that defines scientific impact, is to acknowledge cognitive-intellectual influences and to give “*credit where credit is due*” (Leydesdorff, 1998; Merton, 1973, p.307). Citations generally encompass a continuum from making connections to related work to more substantial engagements with the knowledge contributions of the cited paper. They have therefore been considered to be a vote of the citing authors that the cited work was related to and relevant for their own paper (Doyle, Arthurs, McAulay, and Osborne, 1996). Overall, scientific impact is also considered to provide insights into the cumulative development of knowledge (Hassan and Loebbecke, 2017)².

Consistent with this perspective, the first goal of this thesis is to advance explanations of scientific impact as a basis for understanding and developing impactful papers that stimulate knowledge development. While analyses of scientific impact are appealing due to their efficiency and due to the broad recognition of the importance of citation scores, they are typically based on the assumption that all citations are equal (Smith, 1981). Critically reflecting on this assumption, the scientometric literature recognizes differences in citation types, distinguishing citations that are not integral to a paper from citations that represent stronger engagement with the cited paper and therefore reflect more substantial knowledge development (Hassan and Loebbecke, 2017; Moravcsik and Murugesan, 1975). In this regard, the second goal of this thesis is to advance

² Specific conceptions of knowledge are discussed in Section 2.2.

the distinction of different types of scientific impact to facilitate a more informed discourse on cumulative knowledge development in Information Systems (IS).

The papers included in this thesis focus on review articles (RAs) and design science research (DSR)³, two distinct and characteristic genres in IS⁴. In both, the literature on RAs and DSR, the importance of achieving cumulative knowledge development, or scientific impact, has been emphasized repeatedly. With regard to RAs, Rowe (2014) states that the considerable scientific impact of RAs reflects their “*tremendous value for the field*” (p. 242) and Leidner (2018), herself an author, reviewer, and editor responsible for some of the most impactful RAs in IS, considers scientific impact as a measure for the success of this type of paper (p. 552). Similarly, impact is considered an important criterion for DSR papers, as exemplified by the paper of Gregor and Hevner (2013), entitled “*Positioning and Presenting Design Science Research for Maximum Impact*”.

Research explaining and distinguishing scientific impact of RAs and DSR can generally be considered to be scarce (as outlined in Chapter 2 and the related work sections of the individual papers). It therefore is the central premise of this thesis that those involved in the development of knowledge through RAs and DSR, including authors, reviewers, editors, and methodologists, would benefit from more systematic analyses and deeper insights. Therefore, the overarching research question addressed by the papers in this thesis is:

How can the scientific impact of RAs and DSR be explained and distinguished?

This research question covers an explanatory goal and an analytical⁵ goal (cf. Gregor, 2006), which are addressed for both, RAs and DSR. Beyond these main goals, the papers also make prescriptive contributions, which are summarized in Section 8.2. Figure 1.1 illustrates the main concepts needed to address the two main goals.

Generally, I address the goal of providing explanations of scientific impact by conceptualizing and measuring essential paper characteristics as factors at the journal, author, and paper level and applying regression methodologies to analyze their association with aggregated scientific impact, as measured by citation scores. The second goal zooms in on the dependent variable and distinguishes different types of scientific impact at the more granular level of individual

³ By RA and DSR, I refer to RAs and DSR in IS. I do not claim that results of the papers apply to other disciplines in the same way.

⁴ When I refer to RAs and DSR as genres, my conception of these types of papers is based on the definitions provided in Section 2.1 and in the respective papers forming this thesis. I acknowledge that different genre classifications are used both within the scope of (IS-specific) articles and beyond the scope of academic articles (e.g., Avital, Mathiassen, and Schultze, 2017; Firth and Lawrence, 2003), as reflected by the variety of evolving and partly compatible manuscript categories at IS journals (cf., Rowe, 2014; Webster and Watson, 2002, for exemplary changes in manuscript categories).

⁵ The second goal could also be considered as *descriptive* (cf. Gregor, 2006, p.623).

paper citations⁶. Specifically, I apply both manual and automated classification methods to consider the distinction between superficial ways of citing a paper, i.e., perfunctory impact, and more substantial ways that reflect a stronger engagement with the knowledge contribution of the cited paper, i.e., ideational impact.

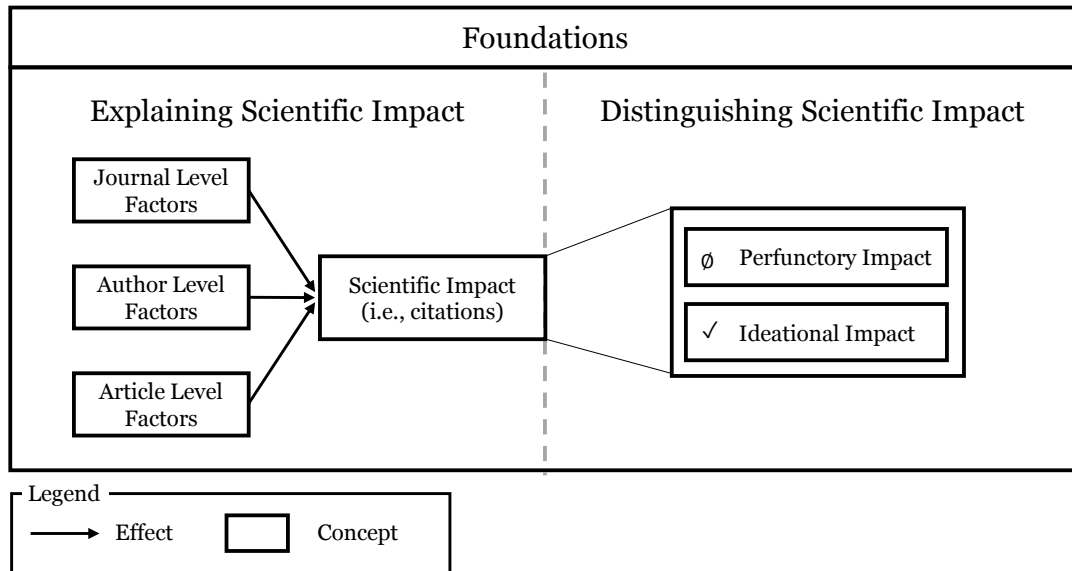


Fig. 1.1: Framework: Explaining and Distinguishing Scientific Impact

In the following sections, I provide an overview of the papers and the research questions they address. Although Chapters 1, 2, and 8 are written from an individual first person perspective (i.e., using *I*), the papers included in Chapter 3 to 7 and by extension, Chapters 1, 2, and 8 also reflect my co-authors' work and points of view.

1.1 Foundations of Scientific Impact

As a step toward addressing the overarching research question, the first paper develops the foundation for analyzing antecedent factors of scientific impact and the different types of scientific impact that align with knowledge development. This paper synthesizes contributions of RAs from a perspective of knowledge development, which addresses the general lack of systematic epistemological analyses of IS research methods recognized in previous literature (e.g., Becker

⁶ Note that the models explaining scientific impact as a dependent variable always require multiple papers (RAs or DSR) and sufficient variance in the dependent variables. In contrast, scientific impact, as a type of relationship, can be distinguished for individual papers.

and Niehaves, 2007). Specifically, I conceptualize different archetypes of knowledge development in Paper 1, which addresses three research questions:

Research Question 1.1 *How can the theory of knowledge be used to develop an epistemological model of knowledge creation through literature reviews?*

Research Question 1.2 *How have IS literature reviews contributed to knowledge creation and how can we foster it in future IS literature reviews?*

Research Question 1.3 *How can the empirical analysis of knowledge creation through IS literature reviews be used to develop an epistemological taxonomy of literature reviews?*

To answer these questions, I analyze the literature on RAs to understand how RAs engage with tacit and explicit knowledge as well as with knowledge at the domain and meta-domain level. In line with this perspective, I develop the theoretical model, the *theory of knowledge for literature reviews*, which aligns contributions of RAs with the underlying modes of knowledge conversion. Methodologically, I apply manual content analysis and classification techniques to over 150 RAs, and inductively develop the taxonomy that aligns with the knowledge contributions.

Paper 1 provides a foundation for the remaining papers. Specifically, the knowledge contributions are used in Paper 2 to develop the antecedent factors of scientific impact and to guide the analysis. In my work leading to the publication of Paper 4, this foundation has informed my analysis by distinguishing the knowledge contributions of the focal papers and these of the citing papers alike, constituting different facets of ideational impact. Beyond RAs, the archetypes of synthesizing, theory building, and developing research agendas, for example, also apply to the genre of DSR. As a scientific paper, DSR papers contain background sections (syntheses), they can contribute to the development of (design) theory (cf. Gregor, 2006; Gregor and Jones, 2007; Walls, Widmeyer, and El Sawy, 1992), and they can guide future research (cf. Markus, Majchrzak, and Gasser, 2002). The emphasis on developing theory and research agendas in the literature on RAs, for example, has raised my awareness for the contributions in the DSR genre (in particular in Paper 5). Literature serving as a foundation for my work on DSR has, in turn, proven useful for my analyses of RAs. For example, the DSR knowledge contribution framework of Gregor and Hevner (2013), which distinguishes novelty of the problem and novelty of the solution⁷ has not only been used as a factor explaining impact of DSR (Paper 3), but it has also informed my work on Paper 2, which focuses on RAs and includes novelty as a robustness check. The background sections and conceptual approaches of the following papers therefore build on and complement the foundation provided in Paper 1.

⁷ Note that Gregor and Hevner (2013) originally refer to maturity instead of novelty. For reasons of consistency with Paper 3, I use the term novelty.

1.2 Explaining Scientific Impact

The first goal of this thesis is to explain what makes RAs and DSR successful in terms of scientific impact. Explaining the scientific impact of papers is appealing to those who aspire to develop memorable papers themselves and strive for thought leadership in their research domains (Stremersch, Verniers, and Verhoef, 2007). This goal of publishing impactful research, or avoiding low-impact papers is shared by publication outlets and all involved in the production of scientific knowledge, including reviewers, editors, and methodologists. In the case of RAs, the IS discipline can certainly learn from its sister disciplines, such as the health sciences, in which the challenge of proliferating RAs with varying degrees of quality and usefulness has been debated critically (e.g., Ketcham and Crawford, 2007).

While explanatory models of scientific impact are available for general empirical and theoretical research papers in IS (Grover, Raman, and Stubblefield, 2013; Tams and Grover, 2010) and its sister disciplines (e.g., Bergh, Perry, and Hanke, 2006; Judge, Cable, Colbert, and Rynes, 2007; Mingers and Xu, 2010; Stremersch et al., 2007), there is limited research explaining the scientific impact of RAs and DSR in IS. In the particular cases of RAs and DSR, the discourse also offers widely different ideas about the characteristics of high quality RAs and DSR (I discuss this aspect in Section 8.1). Since RAs and DSR apply different methodologies and make different knowledge contributions than general research papers (cf. Section 2.1 for definitions and characteristics), results of existing models of scientific impact cannot be expected to be representative for these types of papers. The selected types of papers can even be considered extremes since there are order of magnitude differences between RAs, which are traditionally known as a high impact genre (with an average of 200 citations and high-impact RAs surpassing 10,000) and DSR, which is known to exert lower scientific impact (with an average of 50 citations and high-impact DSR surpassing 1,000)⁸.

To explain the scientific impact of RAs and DSR, I develop and test scientometric impact models whose factors⁹ are structured according to the journal, author, and article level (cf., Judge et al., 2007; Tahamtan, Afshar, and Ahamdzadeh, 2016). In deriving these factors, I go beyond extant scientometric research and consider the recommendations of methodologists and editors on essential qualities of RAs and DSR, such as methodological transparency and novelty. Since citing a paper is a cognitive act of the citing authors, valid explanations of scientific impact need to consider a range of factors that may influence these decisions. I therefore consider both the normative and social constructivist theories of citing behavior, which conceive citing decisions as being influenced by the content of the cited paper or by the prominence of the authors, respectively (Section 2.3 provides an overview of both theories).

⁸ The approximate figures are based on Papers 2 and 3; they were calculated for a comparable scope of journals and time.

⁹ Note that we use the term *factor* without conducting formal factor analyses.

Regarding the scientific impact of RAs, I develop and test an explanatory model (Paper 2), which addresses the following research question:

Research Question 2 *What are the attributes that affect the scientific impact of review papers?*

To address this question, the impact model covers a range of antecedent factors, including the influence of journal visibility, the effects of teamwork between and beyond the authors of a paper, differences in research domains, and methodological reporting practices. Overall, I distinguish reviews for describing, understanding, explaining, and theory testing (Rowe, 2014) and analyze the differing effects of factors pertaining to methodological reporting practices (transparency) and the development of a research agenda. I thereby focus on factors that have rarely been included in scientometric models despite their importance in methodological and editorial papers (e.g., Paré, Tate, Johnstone, and Kitsiou, 2016; Rowe, 2014; Templier and Paré, 2018; Webster and Watson, 2002).

Regarding the scientific impact of DSR, I develop and test an impact model (Paper 3), which addresses following research question:

Research Question 3 *What are the most influential DSR papers in information systems and which factors explain their scientific impact?*

Addressing this question, the impact model focuses on the paper-level factors of novelty and theorization as two essential qualities of DSR that have been discussed frequently in extant literature (e.g., Gregor and Hevner, 2013; Gregor and Jones, 2007; Markus et al., 2002; Walls et al., 1992)¹⁰. By explaining scientific impact for this type of paper, I emphasize the goal of producing scientific knowledge, which complements the goal of developing novel artefacts that are useful for practitioners.

Methodologically, both papers are based on generalized linear models (GLMs) that regress the dependent variable of citations on its antecedent factors. The variables were constructed based on manual content analyses of the full-text, and (semi) automated extraction of publication meta-data from the full-text, literature databases, and citation indices. Since (adjusted) citation scores are count data that tend to include many zero values, I use GLMs to estimate the effects of the factors included in the respective models. This approach aligns with other scientometric models that have been suggested in previous research (e.g., Grover et al., 2013; Mingers and Xu, 2010; Tahamtan et al., 2016). Methodological challenges, such as the assumptions of the regression analyses are discussed in Section 2.3 and in the respective papers.

¹⁰ The discourse on methodological transparency of DSR is not yet mature enough (especially compared to the discourse on transparency and systematicity of RAs, cf. Paré, Trudel, Jaana, and Kitsiou (2015); Templier and Paré (2018)) to allow for reliable measurement and inclusion of this aspect in the model. The level of theorization, in turn, cannot be included as a fair criterion of all types of RAs.

In summary, Papers 2 and 3 provide explanations of scientific impact for RAs and DSR by advancing scientometric impact models that are adapted to the specifics of each type of paper. In both cases, citation scores can also be considered as a proxy variable for (cumulative) knowledge development (Hassan and Loebbecke, 2017; Weber, 1987). This association is further discussed in Section 2.2.

1.3 Distinguishing Scientific Impact

Research distinguishing types of scientific impact recognizes that not all citations are equal (Smith, 1981), and that scientific impact reflects different ways and degrees of engaging with the cited paper. While the literature offers a range of different ways to classify types of citations, or scientific impact (cf. Section 2.4 for an overview), the papers included in this thesis focus on distinguishing ideational from perfunctory impact. This distinction is considered both on a binary and on a more granular level of classification, e.g., distinguishing different types of ideational impact such as theory testing and theory extension. When papers use citations as symbolic representations of the ideas expressed in the cited document (Small, 1978, p.327) and develop its main knowledge contributions further, they represent ideational impact. Citing papers whose knowledge contributions are weakly related to those of the cited paper represent perfunctory impact (cf. Hansen, Lyytinen, and Markus, 2006; Hassan and Loebbecke, 2017). Examples for the prior include subsequent testing or extending of a theoretical paper (cf. Colquitt and Zapata-Phelan, 2007; Fisher and Aguinis, 2017). Examples of the latter include mentioning a paper as related work on the topic, which is one of the most common ways of citing previous research (Case and Higgins, 2000)¹¹. When assessing knowledge development stimulated by certain papers, it is necessary to consider these differences, to zoom in on the types of scientific impact stimulated by RAs and DSR, and to identify those citing papers that represent stronger contributions to cumulative knowledge development.

RAs, which are recognized as a high-impact genre (e.g., Barrios, Guilera, and Gómez-Benito, 2013; Judge et al., 2007; Mingers and Xu, 2010), have been suspected to be a type of paper that is particularly susceptible to exert high perfunctory impact. They have been referred to as a type of paper that lacks originality and novelty (e.g., Grover et al., 2013) and “*mask[s]*” the contributions of other research papers by including them in the synthesis (May, 1997, p.796). With an increasing overall paper output and limited space to cite all papers, RAs can “*serve as surrogates for long lists of relevant works*”, thereby leading to “*obliteration by incorporation*” (Garfield, 1996, p.456). Scientific impact, as measured by citation scores, has therefore been considered to give “*undue weight*” to RAs (Hirsch, 2005, p.16569). In fact, RAs can be considered as a prime example to question the validity of scientific impact as a proxy variable of ideational

¹¹ In contrast to Cuellar, Vidgen, Takeda, and Truex (2016) and in accordance with Hansen et al. (2006) and Hassan and Loebbecke (2017), we do not consider mentions of related work as ideational impact.

impact, or cumulative knowledge development¹². The scientific impact of RAs, which have been recognized to go beyond pure syntheses and aggregation of evidence in the IS discipline (cf. Paper 1), provides an exemplary context to expose this sentiment to a more systematic analysis.

In Paper 4, I provide an analysis of ideational and perfunctory impact of RAs, answering the following research question:

Research Question 4 *How effectively can NLP-based approaches classify the ideational impact of IS review articles?*

To address this question, I manually distinguish perfunctory from ideational impact for more than 1,000 papers citing RAs in the IS-business value domain. This data-set serves as a basis for developing machine learning classifiers that automate this classification task. The classifiers are based on semantic and contextual features, such as the occurrence of in-text citations in different parts of the citing paper and natural language processing (NLP) based topic models that reflect the type of citation. This approach is intended to make the distinction of perfunctory and ideational impact more replicable, efficient, and therefore applicable on a larger scale. Overall, Paper 4 thereby extends the arsenal of methods for analyzing ideational impact and cumulative knowledge development.

In DSR, information systems design theories (ISDTs) are expected to be the primary drivers of knowledge accumulation (e.g., Gregor and Jones, 2007). At the same time, these expectations may not be shared by those espousing a pragmatic, rather than a theoretical focus of DSR (cf. Gregor and Hevner, 2013). With regard to these competing conceptions of DSR, the discourse would arguably benefit from a better understanding of the degree to which theoretical DSR has stimulated cumulative knowledge development, or different types of ideational impact in subsequent literature.

Paper 5 addresses the question of distinguishing types of scientific impact for DSR papers presenting design theories:

Research Question 5 *How and to what extent has subsequent research tested and extended ISDTs?*

To answer this question, I analyze the ideational impact of seven design theories that have been published in the Association for Information Systems (AIS) Senior Scholars' basket of journals. I specifically focus on two archetypal ways of building on theoretical papers: theory testing and theory extension. These ways of engaging with theoretical papers have repeatedly been recognized as essential for knowledge development (e.g., Colquitt and Zapata-Phelan, 2007; Fisher and Aguinis, 2017). Overall, the qualitative coding methodology¹³ aims at assessing the

¹² This was pointed out by a reviewer on the conference version of Paper 2. As the previous excerpts from the literature show, this argument resonates with the literature.

¹³ Since ideational impact was extremely scarce in the sample that was analyzed in Paper 5, it was not feasible to train machine learning classifiers accordingly.

amount of follow-up research and the progress of design theories in developing a tradition of cumulative knowledge development. With regard to DSR, I consider perfunctory impact not only in terms of review mentions but also in terms of references to the meta-discourse on DSR. This meta-discourse is concerned with how DSR should contribute to developing design theory as well as solutions to practical problems (e.g., Gregor and Jones, 2007), and how DSR should be conducted and presented (e.g., Gregor and Hevner, 2013). Due to the breadth and prominence of this discourse compared to actual DSR papers¹⁴, it is not evident to which degree DSR papers that develop artefacts and/or design theory have stimulated ideational impact. To guide future research, I derive several guidelines that are targeted towards prospective authors of design theories and follow-up research.

1.4 Structure of the Thesis

The papers that are included in this thesis can be matched to the research goals and paper types (objects of analysis) that constitute the dimensions of the overarching research framework (cf. Figure 1.2).

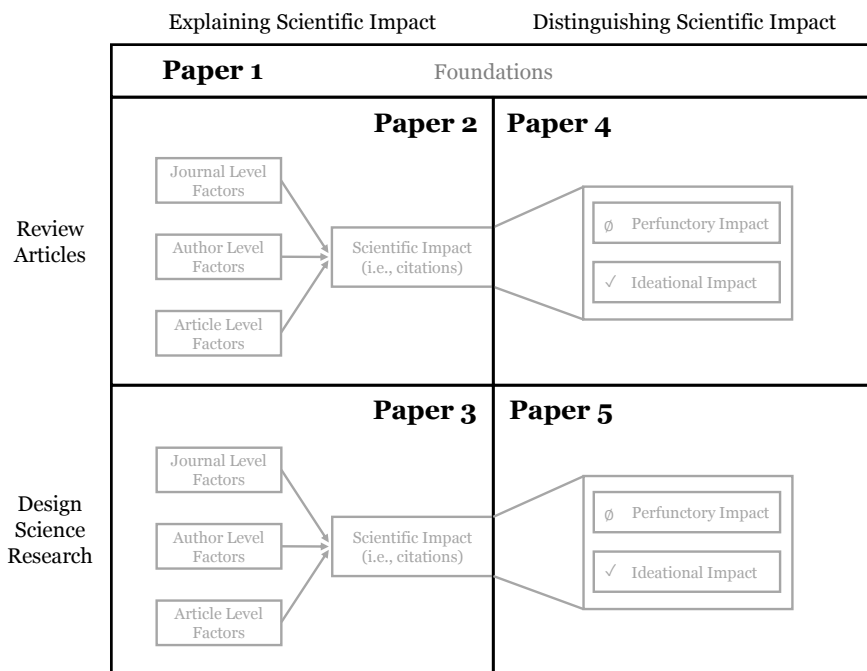


Fig. 1.2: Framework: Research Goals, Objects of Analysis (RAs and DSR), and Papers

The papers included in this thesis and their mapping to the research questions is provided in Table 1.1. Each paper was edited to provide a consistent presentation and layout. In addition, the papers listed in Appendix A were (partly) developed during the time of my thesis. They are not part of the thesis.

¹⁴ Teufel, Siddharthan, and Tidhar (2006) refer to this as the *object-level* discourse.

As illustrated in Figure 1.2 and Table 1.1, this thesis is structured as follows. Chapter 2 provides the background and a broader conceptual foundation for the papers which form the body of the thesis. The papers addressing the research questions for both genres are provided in Chapters 3 to 7. Chapter 8 recaptures the main contributions, implications and research opportunities before concluding this thesis.

Table 1.1: Overview of the Research Questions and Papers

Research Question	Paper
Chapter 3: Foundation of Review Articles	
Research Question 1.1 <i>How can the theory of knowledge be used to develop an epistemological model of knowledge creation through literature reviews?</i>	Paper 1 Schryen, G., Wagner, G., and Benlian, A. 2015. Theory of Knowledge for Literature Reviews: An Epistemological Model, Taxonomy and Empirical Analysis of IS Literature, in Carte, T., Heinzl, A., and Urquhart, C. (Eds.), <i>Proceedings of the 36th International Conference on Information Systems</i> , pages 1-22, December 13-16, Fort Worth, Texas, USA. Association for Information Systems.
Research Question 1.2 <i>How have IS literature reviews contributed to knowledge creation and how can we foster it in future IS literature reviews?</i>	
Research Question 1.3 <i>How can the empirical analysis of knowledge creation through IS literature reviews be used to develop an epistemological taxonomy of literature reviews?</i>	
Chapter 4: Explaining the Scientific Impact of Review Articles	
Research Question 2 <i>What are the attributes that affect the scientific impact of review papers?</i>	Paper 2 Wagner, G., Prester, J., Roche, M., Benlian, A., Schryen, G., Paré, G. and Templier, M. Which Factors Affect the Scientific Impact of Review Papers in IS Research? A Scientometric Study, Under Review at the <i>European Journal of Information Systems</i> .
Chapter 5: Explaining the Scientific Impact of Design Science Research	
Research Question 3 <i>What are the most influential DSR papers in information systems and which factors explain their scientific impact?</i>	Paper 3 Wagner, G., Prester, J., and Schryen, G. 2017. Exploring the Scientific Impact of Information Systems Design Science Research: A Scientometric Study, in Kim, Y.J., Agarwal, R., and Lee, J.K. (Eds.), <i>Proceedings of the 38th International Conference on Information Systems</i> , pages 1-24, December 10-13, Seoul, South Korea. Association for Information Systems.
Chapter 6: Distinguishing the Scientific Impact of Review Articles	
Research Question 4 <i>How effectively can NLP-based approaches classify the ideational impact of IS review articles?</i>	Paper 4 Prester, J., Wagner, G., and Schryen, G. 2018. Classifying the Ideational Impact of IS Review Articles: A Natural Language Processing Based Approach, in Pries-Heje, J., Ram, S., and Rosemann, M. (Eds.), <i>Proceedings of the 39th International Conference on Information Systems</i> , pages 1-17, December 13-16, San Francisco, California, USA. Association for Information Systems.
Chapter 7: Distinguishing the Scientific Impact of Design Science Research	
Research Question 5 <i>How and to what extent has subsequent research tested and extended ISDTs?</i>	Paper 5 Schuster, R., Wagner, G., and Schryen, G. 2018. Information Systems Design Science Research and Cumulative Knowledge Development: An Exploratory Study, in Pries-Heje, J., Ram, S., and Rosemann, M. (Eds.), <i>Proceedings of the 39th International Conference on Information Systems</i> , pages 1-17, December 13-16, San Francisco, California, USA. Association for Information Systems.

Background

In this chapter, I develop a more comprehensive background that constitutes the foundation of the following papers. First, I provide definitions for RAs and DSR, which serve as a broader frame for the specific definitions adopted in each paper. Second, I clarify conceptions of scientific impact that are common in the literature and discuss related concepts such as knowledge development and quality. Third, I illustrate the anatomy of models explaining scientific impact, considering theoretical rationales, methodological aspects, and empirical studies. Finally, I outline facets of scientific impact that are distinguished in the literature.

2.1 Defining Review Articles and Design Science Research

To provide an overview of the objects of analysis, I summarize definitions of RAs and DSR from the literature, discuss how they relate to the definitions adopted in the papers, and what makes them specific to IS.

RAs can broadly be defined as “*articles that do not contain original data and simply collect, review and synthesize earlier research, without including substantial theoretical or conceptual development*” (Harzing, 2013, p.3)¹⁵. While this general definition provides a starting point for many social science disciplines, conceptions of RAs in IS literature uncover aspects that are specific to this discipline. There is agreement that IS-RAs do not collect primary data (e.g., Okoli, 2015; Paré et al., 2015), but there are claims that, contrary to Harzing’s (2013) general definition, RAs should engage in *theoretical development* in IS. For example, Webster and Watson (2002) envision that the two types of reviews – addressing mature vs. emergent topics – should result in a conceptual model with theory development constituting the “*most important part of a review*” (p.xix). This view is consistent with following editorials (e.g., Leidner, 2018; Rivard, 2014). Some definitions of RAs further engage with qualities of the methodological process, for example by defining RAs as a “*systematic, explicit, and reproducible method for identifying, evaluating, and synthesizing the existing body of completed and recorded work produced by researchers, scholars,*

¹⁵ Despite focusing on review *articles* as standalone articles, I acknowledge that there are related forms of literature reviews, such as *literature review* or *related work* sections that are included in different types of papers. They are out of scope in this thesis.

and practitioners” (Fink, 2014, p.3). Conceptualizing the related concepts of systematicity and transparency as a response to recent debates on this issue (e.g., Boell and Cecez-Kecmanovic, 2015b; Oates, 2015; Schultze, 2015; Watson, 2015), Paré et al. (2016) and Templier and Paré (2018) suggest that these methodological characteristics vary throughout different types of reviews. Qualities of the methodological process may therefore be more useful for distinguishing rigorous RAs from those that are less rigorous, than for distinguishing whether a given paper is an RA or not. For the scope of the papers included in this thesis, I develop a definition which reflects the three properties of (1) including a synthesis, (2) focusing on domain knowledge, and (3) being comprehensive. While these properties are justified in detail in Paper 1, it should be noted that the papers included in this thesis focus on analyzing RAs which review domain knowledge (property 2), and that RAs reviewing research methodologies are out of scope.

DSR, as a type of research, is “*concerned not with the necessary but with the contingent not with how things are but with how they might be in short, with design*” (Simon, 1969, p.xii). IS-DSR has been associated repeatedly with the notion of *Sciences of the Artificial*, which was originally suggested by Simon (1969) (e.g., Gregor, 2006, 2009). For example, Hevner, March, Park, and Ram (2004) state that DSR “*seeks to extend the boundaries of human and organizational capabilities by creating new and innovative artifacts*” (p.75) and March and Smith (1995) describe DSR, which “*attempts to create things that serve human purposes*” (p.253), as having prescriptive intent. This perspective on DSR as creating prescriptive knowledge can be considered as suggesting effective artefacts or courses of action to achieve particular goals; it is not normative in a sense that it entails a moral or ethical judgment (Gregor, 2006; Myers and Venable, 2014). DSR needs to be distinguished from routine design, which describes the professional “*application of existing knowledge to organizational problems*” (Gregor and Hevner, 2013, p.347). In contrast, a critical aspect of DSR, as a scientific type of paper, is that it creates new knowledge and communicates that knowledge to academic and practitioner audiences (cf. Gregor and Hevner, 2013). Considering that DSR in IS has been influenced by other disciplines, such as computer science and operations research, it needs to be distinguished from related research in its sister disciplines. While strict definitions and criteria are elusive, IS-DSR can be considered as developing a variety of socio-technical artefacts (e.g., Gregor and Hevner, 2013; Niederman and March, 2012). One implication of this focus on socio-technical artefacts, which characterizes DSR in IS, is that the evaluation of artefacts typically requires observational empirical data, which is not the case for primarily technical DSR, such as the relational database theory (Codd, 1970). Research focusing on the extremes of this continuum may not be considered to be IS-specific; for example, DSR developing purely technical artefacts may be situated in the computer science discipline and research not engaging with the IT artefact may be situated in the organizational science discipline.

To further clarify DSR as the object of analysis in Papers 3 and 5, it is useful to conceive the DSR literature as spanning (1) papers that contribute to the methodological, meta-theoretical,

philosophical, and epistemological discourse, and (2) papers that directly contribute to the development of DSR domain knowledge. My research focuses on papers of the latter type, which can be thought of as papers *actually doing DSR* (cf. Papers 3 and 5) by developing constructs, methods, or models (March and Smith, 1995), or design theory (cf. e.g., Gregor and Jones, 2007; Walls et al., 1992)¹⁶. In doing so, these papers contribute to both, creating scientific knowledge and practical utility (Hevner et al., 2004).

2.2 Foundations of Scientific Impact

Scientific impact is a concept receiving attention in disciplinary (e.g., Bergh et al., 2006; Judge et al., 2007; Stremersch et al., 2007) and interdisciplinary journals (e.g., Fortunato et al., 2018; King, 2004; Uzzi, Mukherjee, Stringer, and Jones, 2013). One of the few papers that provide a conceptual definition is the one of Grover et al. (2013), who conceive scientific impact as “*the degree to which that research article influences the work of other researchers*” (p.1441). This impact can be analyzed for individual citing papers and for aggregated sets of citing papers. Since conceptual definitions are rare, we follow the majority of papers analyzing scientific impact and define it in terms of its measurement, i.e., citation scores. As an example, Bollen, Van de Sompel, Hagberg, and Chute (2009) explicitly state that they “*do not have a workable definition of the notion of scientific impact itself, unless we revert to the tautology of defining it as the number of citations received by a publication*” (p.2). In the following, I discuss alternative measures for scientific impact as well as the concepts of knowledge development and quality, which are often associated with citation scores¹⁷. Since many of these concepts are not defined clearly and unanimously, I illustrate the range of concepts associated with citations rather than suggesting distinctness.

Although citation scores are the most common measure of scientific impact, complementary measures have been considered in recent literature. Many of these new measures are related to usage of articles in terms of clicks, downloads, and reads (cf. Bollen et al., 2009, for a review and empirical comparison). Related approaches, such as the development of Altmetrics provide metrics complementing traditional citation scores and focus on the impact of research on social networks (Fenner, 2014), including Twitter (e.g., Eysenbach, 2011), and Researchgate (e.g., Hoffmann, Lutz, and Meckel, 2016), for example. Promising to provide valuable insights into

¹⁶ In contrast to RAs, we think it is necessary to clarify this distinction for DSR since many papers contributing to the *reflection of artefact construction or evaluation* (Winter, 2008, p.472) formalize their results as process or classification artefacts. For example, Peffers, Tuunanen, Rothenberger, and Chatterjee (2007) reflect on how DSR should be conducted and codify their recommendations in the DSRM process, i.e., an artefact. These types of DSR are out of scope in Papers 3 and 5, however, since they primarily target academic audiences, as opposed to solving practical problems.

¹⁷ Note that the concepts outlined in the following are associated with the measure of citation scores in some parts of the literature. Distinguishing these concepts at a conceptual level is elusive since there is no commonly agreed definition for the concepts of knowledge or quality and since scientific impact is rarely defined conceptually.

the first stages of knowledge dissemination in scientific communities (e.g., sharing and reading papers), discrepancies may arise if early attention, i.e., high usage statistics, does not translate into actual use of papers, i.e., citations.

To further clarify scientific impact, I consider how extant literature delineates it from (cumulative) knowledge development and the related concept of quality. Knowledge development is a central concept that is often associated with scientific impact. In a recent review of the scientometric field, Fortunato et al. (2018) conceive scientific papers as representations of knowledge which are connected through flows of information, such as formal citations (p.1). This view is consistent with many scientometric studies (e.g., Fortunato et al., 2018; Price, 1965; Uzzi et al., 2013), and it can also be recognized in the paper of Hassan and Loebbecke (2017), whose review of scientometric work in the IS discipline explores implications of citation patterns for the development of IS knowledge. Despite referring to philosophy of knowledge (epistemology) explicitly, the paper of Hassan and Loebbecke (2017), like the majority of scientometric studies, does not engage with specific epistemological paradigms or corresponding conceptions of knowledge. These epistemological definitions of knowledge can be considered specific instances of the ancient definition of knowledge as “*justified true belief*” (Greco and Sosa, 1999). A belief, generally, refers to the attitude of individuals, when they “*take something to be the case, regard it as true, or accept it*” (Bernecker, 2010, p.83). Different and incommensurable conceptions of truth are the foundation for epistemological paradigms, such as positivism, interpretivism, and the critical paradigm, which have been recognized in IS research (Chen and Hirschheim, 2004). Justification through scientific methods refers to “*a common set of procedures on which a science and its investigators accept or discard hypotheses or criticize new knowledge claims of peers*” (Kaplan (2017) as summarized by Khazanchi and Munkvold (2000, p.36)). Resembling the discourse on knowledge accumulation in the strategic management discipline (Langley, 2010, p.92), papers associating scientific impact with knowledge development in IS tend to follow positivist models of science, the mode of normal science as characterized by Kuhn (1970), or empiricist models that endorse the systematic accumulation of evidence and informing practice as the primary goal of science (cf. Weber, 1987).

In contrast to these more traditional epistemological paradigms, it is noteworthy that few scientometric studies engage with more contemporary conceptions of science and knowledge development. Notably, the philosophy of Popper (2014) and the revolutionary aspects of scientific progress described by Kuhn (1970) are not well captured by cumulative citation scores since one revolutionary paper or successful attempt of falsification that disrupts the process of cumulative knowledge development could render previously accumulated citation scores meaningless. Other philosophies of science and knowledge deem more consistent with the assumptions of citation analyses. One example is the notion of methodological pluralism, which may at least partly align with the philosophy of Feyerabend (1993), who challenges the assumption that any scientific

method should be granted a “*special status*” (Chalmers, 2013, p.193)¹⁸. Ideals of methodological and epistemological pluralism, which are arguably relevant for IS (Benbasat and Weber, 1996; Landry and Banville, 1992), could provide a basis for considering research contributions adhering to different paradigms as contributing to scientific impact as a common indicator of knowledge accumulation.

A further concept that is associated with scientific impact is quality (e.g., Straub, 2008; Tahamtan et al., 2016; Tams and Grover, 2010). Equating quality with citation scores can be criticized for various reasons¹⁹, and including quality as an antecedent factor of impact requires reliable measures. There is, however, a lack of reliable ways to quantify the quality of papers (Tahamtan et al., 2016), and existing assessments of quality of papers can lead to less objective (Weber, 1987) and widely discrepant results (cf., e.g., Colquitt and Zapata-Phelan, 2007, p.1297). While assessments of overall paper quality may remain a contested issue, citations can be conceived as “*effortful voting*” of the scientific community, thereby contributing to the specific quality of relevance (Doyle et al., 1996).

Having outlined definitions of scientific impact and its association with knowledge and quality, the following two sections review related work on two types of analyses of scientific impact: (1) Models explaining scientific impact, and (2) analyses distinguishing types of scientific impact. I thereby focus on the two types of analyses involving scientific impact that are relevant for the papers included in this thesis. Further analyses related to scientific impact, such as ranking studies of authors and journals (cf. Hassan and Loebbecke (2017) for an overview), and science mapping approaches drawing on citations (cf. Smith, 1981), are out of scope.

2.3 Models Explaining Scientific Impact

The scientific impact of papers is typically explained by factors that can be structured according to the journal, author, and paper level. The framework displayed in Figure 2.1 summarizes this anatomy of scientometric impact models can be recognized in many studies (e.g., Bergh et al., 2006; Judge et al., 2007; Stremersch et al., 2007; Tahamtan et al., 2016). In the following, I outline two theories of citing behavior that inform the model development. I further provide an overview of common factors suggested in the literature and discuss methodological challenges. Finally, I summarize how Papers 2 and 3 relate to extant research.

¹⁸ Focusing on the notion of methodological pluralism, the philosophy of Feyerabend may provide a basis for conceiving *scientific impact* as *knowledge accumulation* across different types of research, methodologies, and paradigms. However, associating *scientific impact* with *scientific progress* is not consistent with this philosophy (cf. Feyerabend, 1975)

¹⁹ For example, there are general biases and methodological problems (Seglen, 1992), and opposing evidence, such as the work of Nobel laureates that sometimes receives low citation scores (cf. Van Noorden, 2017).

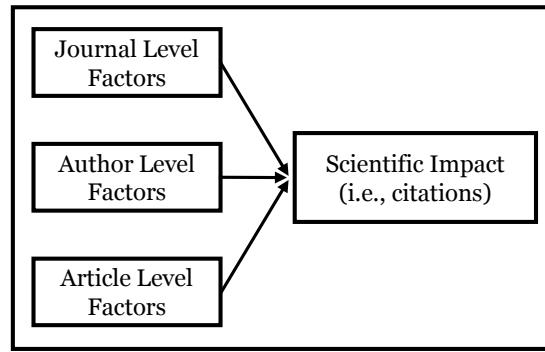


Fig. 2.1: Framework: Factors Explaining Scientific Impact

The three-level framework can be considered to align with two competing theories of citing behavior, the normative and the constructivist theory. In advancing the prior, Merton (1988), contends that “*The reference serves both instrumental and symbolic functions in the transmission and enlargement of knowledge*” (p.622). It is consistent with conceiving citations as the act of “*giving credit where credit is due*” (Merton, 1973, p.307), i.e., when ideas are adopted from the cited paper. This theory generally provides a rationale for antecedent factors at the paper level that increase a paper’s likelihood of stimulating knowledge creation and thereby driving scientific impact in subsequent research.

The constructivist theory contends that scientific knowledge is socially constructed and that authors use citations as rhetorical devices (Gilbert, 1977, p.115) to persuade the scientific community (Bornmann and Daniel, 2008; Knorr Cetina, 1991). According to this theory, scientists strive for recognition of their research as “*new, important and true*”; since these qualities are “*not normally self-evident to the readers of a research paper*”, authors employ citations to persuade their audience, e.g., by relating their findings to extant literature, providing references supporting their methodological and theoretical approach, and citing counterarguments that have been considered (Gilbert, 1977, p.116). The constructivist theory of citing behavior therefore contends that authors tend to refer to *authoritative* papers to support their argument (Moed and Garfield, 2004).

The relationship between both theories and the factors of the three-level framework is ambiguous in extant scientometric literature. Some studies conceive the two theories as competing explanations of citing decisions and compare their relative explanatory power (Bornmann and Daniel, 2008). Evidence from interviews of authors, for example, tends to favor the normative theory (Shadish, Tolliver, Gray, and Gupta, 1995; Thornley et al., 2015). Others suggest that both theories do not offer mutually exclusive but complementary explanations which can be integrated in a common model (e.g., Small, 2004). This inconclusive state of the literature on theories of citing behavior may be a reason for the variety of ways in which factors included in impact models are connected to these theories. In general, the theories tend to serve as jus-

tifications for individual variables and not as overarching frameworks (e.g., Judge et al., 2007; Stremersch et al., 2007). Other studies focusing on explanatory models of impact do not attempt to connect their work to these theoretical rationales (e.g., Bergh et al., 2006; Tahamtan et al., 2016). Gathering support for or against either of both theories would require different methodological approaches, such as surveys of the authors' intentions to cite particular papers. In my work, the theories inform the development of scientometric models but the empirical analyses are not designed to confirm or reject the theories; instead, they are designed to explain what makes papers impactful overall.

I summarize antecedent factors at the three levels in Table 2.1, which is based on the comprehensive review of Tahamtan et al. (2016). The overview generally covers antecedent factors included in scientometric studies both within the IS discipline (e.g., Grover et al., 2013; Mingers and Xu, 2010; Tams and Grover, 2010) and beyond (e.g., Bergh et al., 2006; Judge et al., 2007; Stremersch et al., 2007). For the purpose of clarity, minor adjustments were made to the categories suggested by (Tahamtan et al., 2016), such as combining factors in the *demographics* category. Although prediction accuracy of citation scores can be improved if early citations are included as an antecedent factor (e.g., Chakraborty, Kumar, Goyal, Ganguly, and Mukherjee, 2014), I exclude this category because the explanatory value gained by including early citations as a predictor of cumulative citations is limited. Since the papers included in this thesis focus on paper-level factors that are related to content as opposed to meta-data, Table 2.1 presents them in a corresponding order²⁰, starting with factors related to meta-data. For example, the categories of the age of publication and the keywords are common meta-data indexed by most literature databases while the methodology and quality of a paper are inherently content-related. Content-related factors extracted from the full-text of papers have been shown to provide significantly better explanations of scientific impact than factors that are based on meta-data exclusively (cf. McKeown et al., 2016).

Methodological challenges and the lack of a shared theoretical model make it difficult to assess the cumulative evidence on the effects of the respective factors. First, a variety of measures is available in the scientometric literature, which increases the diversity of factors included in scientometric impact models. For example, there are at least 37 different variants of the h-index (Bornmann, Mutz, Hug, and Daniel, 2011). Second, justification for the selection of particular factors is lacking compared to more mature research streams. In this regard, the absence of a shared theoretical model can be considered as contributing to both errors of inclusion and exclusion. Large-scale studies that include primarily factors constructed from meta-data pose the risk of “fishing expeditions” and kitchen sink models, in which significant associations occurring by chance are overinterpreted (Edmondson and McManus, 2007). In contrast, missing factors can threaten the validity of conclusions on the effect size and significance of other factors included

²⁰ Although disagreements on particular positions may arise in some cases, I hope the order is useful to illustrate the focus of my research.

Table 2.1: Factors at the Journal, Author, and Paper Level (based on Tahamtan et al. (2016))

Level	Factor Category
Journal	Journal impact and prestige
	Scope and coverage of journal
	Form of publication (conference, journal)
Author	Demographics (gender, age, race, country)
	Number of authors
	Author's reputation and previous citations
	Author's academic rank
	Self-citations
	Collaboration of the authors (international and national)
	Author's productivity
	Organization of the authors
	Funding and grants received by authors
Paper	Age of the cited paper
	Accessibility and visibility of papers
	Language of the paper
	Length of paper or sections
	Characteristics of the title, abstract and keywords
	Type of paper or study
	Field or topic (reference discipline, keywords)
	Level of analysis
	Presentation and use of figures and appendices
	Characteristics of the references
	Characteristics of the results and discussion
	Methodology
	Novelty, popularity and interest of subject
Qualities of the paper (e.g., theorization)	

in the model; this problem might occur in studies that do not include factors related to the methodology, novelty, or quality of the papers. These errors of exclusion may be due to the efforts required to extract data related to these content-based factors from samples covering hundreds or thousands of papers. The conspicuous absence of robustness checks in many analyses of scientific impact reinforces this point. Finally, a critical aspect of variable selection is related to conceptual and empirical independence between the factors. Since correlations and multicollinearity between factors limit conclusions about the effects of individual predictors, such dependencies must be considered carefully. For example, they may exist between the type of paper (e.g., editorials vs. RAs) and its length, methodology, references, and structure. Further dependencies can be suspected based on Table 2.1.

Compared to extant research, Papers 2 and 3 adopt the following approach. They analyze relatively homogeneous sets of papers and do not pool different types of papers in the same sample to avoid correlations and multicollinearity. The focus lies on paper level factors which are related to the content of the paper and therefore require access to the full-text of the papers and manual content analysis. To develop these factors, I draw on the methodological and editorial literature, which has a tradition of discussing characteristics deemed important for the respective types of paper. This literature thereby complements the scientometric literature, which is still in the early stages of developing factors specific to paper types. While extant research has

developed impact models that include many factors (often ranging in the double-digits, e.g., Bergh et al., 2006; Judge et al., 2007; Mingers and Xu, 2010), I emphasize parsimony to avoid problems associated with overfitting that occur when models include too many variables. This is accomplished by using few established control variables for influences related to the visibility of the journal, the author, and the paper. Furthermore, my work focuses on the main effects and does not include minor biases, such as those related to demographic factors. In particular in Paper 2, I implement an array of robustness checks to evaluate alternative explanations.

2.4 Analyses Distinguishing Types of Scientific Impact

Disassembling the overarching concept of scientific impact, the literature increasingly recognizes different types of scientific impact (Bornmann and Daniel, 2008). By distinguishing types of scientific impact, research “*probes into the facets of the scientific discourse and picks apart its constituent elements*”²¹. Building on the groundwork of Smith (1981)²², who criticizes the assumption that “*all citations are equal*” (p.89), a range of analyses that distinguish different types of scientific impact has been published. These studies generally apply methods of content analysis to “*intellectually refine*” types of impact (Smith, 1981, p.89).

Conceptually, extant literature has approached this issue from two complementary perspectives, either classifying all references, i.e., backward citations, that have impacted a given paper or classifying how a given paper has impacted subsequent research, i.e., analyzing forward citations (Papers 4 and 5 adopt the second approach). Although analyzing the same relationships (citations) from a conceptual perspective, these studies suggest different classifications of scientific impact, a circumstance which may be explained by differences in the analytical perspectives adopted.

A considerable stream of scientometric studies has focused on references or mentions included in a focal (type of) paper (cf. Bornmann and Daniel, 2008, for a survey). While rarely considering the content of the cited papers in their analyses, these studies are interesting from a scientometric perspective because they offer insights into the nuances of different citation types. Some of the earlier works on this topic are highly granular; Garfield (1965), for example, distinguishes different citation types (or reasons to cite), including *homage to pioneers, giving credit for related work, correcting one’s own work, correcting the work of others, and alerting to forthcoming work* (p.85). Since many of these particular categories may be observed rarely, broader categories have been proposed. Notably, Moravcsik and Murugesan (1975), who classified the references of 30 papers published in *Psychology Review*, distinguish citations according to the dimensions *conceptual* vs. *operational*, *organic* vs. *perfunctory*, *evolutionary* vs. *juxtapositional*,

²¹ This description was suggested by Kai Larsen, who summarized Paper 4 in a video conference.

²² Although citation types have been distinguished earlier (e.g., Garfield, 1965), the paper of Smith (1981) provides a useful and widely recognized overview of major methodological and theoretical aspects of citation analyses.

and *negational* vs. *confirmative* (cf. Figure 2.2). Similar classification schemes have been applied in related studies (cf., Bornmann and Daniel, 2008). Considering my focus on types of scientific impact that reflect a more substantial engagement with the knowledge contributions of the cited paper, the dimension of *organic* vs. *perfunctory* provides related categories. While organic citations are “*truly needed for the understanding of the referring paper*”, perfunctory citations include the “*acknowledgment that some other work in the same general area has been performed*” (Moravcsik and Murugesan, 1975, p.88). Although the category of organic citations is similar to the category of ideational impact, which is discussed in the following, both categories are rarely compared directly in the scientometric literature. A possible reason might be that the organic category is prevalent in studies classifying backward citations while the ideational category of impact is used in studies classifying forward citations.

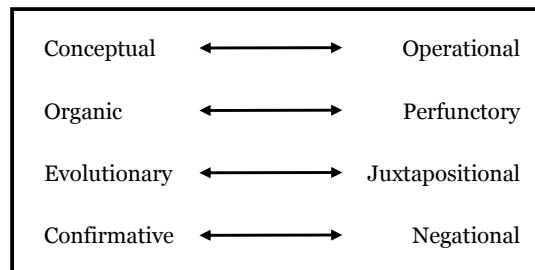


Fig. 2.2: Classification of Types of Scientific Impact (Moravcsik and Murugesan, 1975)

In contrast, my work focuses on classifying different types of scientific impact of focal papers, i.e., forward citations (cf. Figure 2.3). Analyzing how focal papers have impacted subsequent research, I focus on the symbolic perspective (cf. Hassan and Loebbecke, 2017), which considers citations as representing the uptake of scientific work and contributions of the cited paper by the field (Small, 1978; Takeda, Cuellar, Truex, and Vidgen, 2011). Adopting this perspective, I focus on the particular dimension of ideational impact²³. In contrast to perfunctory impact, ideational impact is associated with (cumulative) knowledge development that extends the work of the cited paper. This link can be recognized in the paper of (Hassan and Loebbecke, 2017), who associate the ideational dimension with Keen’s (1980) call for developing a *cumulative research tradition* in IS. By requiring the uptake of ideas to be intertwined with the knowledge development of the citing paper, I adopt a restrictive understanding of ideational impact compared to extant literature (cf. Cuellar et al., 2016; Takeda et al., 2011; Truex, Cuellar, and Takeda, 2009)²⁴. In particular, I consider mentions of related research as not reflecting ideational influence, which aligns with the critique that *not all citations are equal* (Smith, 1981, p.89) and further critical

²³ Note that the recent review of Hassan and Loebbecke (2017) does not mention the different approaches (focusing on backward vs. forward citations) even though these approaches may explain how notably similar categories, such as “*ideational*” and “*organic*” relate to each other.

²⁴ In this literature, other types of impact are considered as negligible biases, which justifies measuring ideational impact in terms of citations and effectively using it as a synonym for scientific impact.

arguments summarized in Section 1.3. To operationalize ideational impact, I further consider different facets of knowledge development have been suggested in the literature; for example, Fisher and Aguinis (2017) suggest that testing and expanding existing theories are “*important facets in the broader knowledge creation process*” (p. 441). Building on my work in Paper 1, I also consider contributions to knowledge development at the meta-domain level, which includes the identification of research gaps and the development of research agendas.

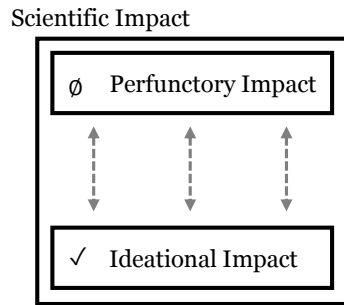


Fig. 2.3: Framework: Distinguishing Types of Scientific Impact

Papers 4 and 5 complement and extend existing research that distinguishes ideational from perfunctory impact (cf. Figure 2.3). In contrast to existing studies adopting a focused approach by analyzing the ideational impact of one individual paper (e.g., Hansen et al., 2006; McCain and Salvucci, 2006), I focus broadly on the impact of RAs and DSR. Facing large quantities of citing papers which have been impacted in different ways, I adopt two approaches. In a first approach, I restrict the topic to the domain of IS business value, which allows me to manually classify a relatively comprehensive dataset and to develop machine learning classifiers to automate the classification (Paper 4). Automated classification has the benefit of scalability and replicability, which have been recognized as particular challenges in this area (e.g., Bornmann and Daniel, 2008). In a second approach (Paper 5), I manually analyze the impact of theoretical DSR, which is substantially lower than the impact of other types of papers (cf. Section 1.2 for an exemplary comparison with RAs).

Foundation of Review Articles

Title:	Theory of Knowledge for Literature Reviews: An Epistemological Model, Taxonomy and Empirical Analysis of IS Literature
Authors:	Guido Schryen, Gerit Wagner, and Alexander Benlian
Status:	Published
Conference:	Thirty-Sixth International Conference on Information Systems (ICIS 2015)
Editors (Program Chairs):	Traci Carte, Armin Heinzl, and Cathy Urquhart
Link	https://aisel.aisnet.org/icis2015/proceedings/ ResearchMethods/8/

Abstract Literature reviews play an important role in the development of knowledge. Yet, we observe a lack of theoretical underpinning of and epistemological insights into how literature reviews can contribute to knowledge creation and have actually contributed in the IS discipline. To address these theoretical and empirical research gaps, we suggest a novel epistemological model of literature reviews. This model allows us to align different contributions of literature reviews with their underlying knowledge conversions - thereby building a bridge between the previously largely unconnected fields of literature reviews and epistemology. We evaluate the appropriateness of the model by conducting an empirical analysis of 173 IS literature reviews which were published in 39 pertinent IS journals between 2000 and 2014. Based on this analysis, we derive an epistemological taxonomy of IS literature reviews, which complements previously suggested typologies.

Keywords Literature review, research methods/methodology, theory of knowledge

Explaining the Scientific Impact of Review Articles

Title: Which Factors Affect the Scientific Impact of Review Papers in IS Research?
A Scientometric Study

Authors: Gerit Wagner, Julian Prester, Maria Roche, Alexander Benlian, Guido Schryen,
Guy Paré, and Mathieu Templier

Status: Under Review

Journal: European Journal of Information Systems

Link <https://epub.uni-regensburg.de/40563/>

Abstract Review papers provide a foundation for knowledge development in information systems (IS) as well as in any other scientific discipline. While some of the prominent reviews in information systems are cited more than twice a day on average, others take years to accumulate single digit citations. The magnitude of these differences and the proliferation of review papers in recent years prompt us to empirically analyze what distinguishes those reviews that have proven to be integral to scientific progress from those that might not be considered impactful. Our results demonstrate that the attributes explaining scientific impact are unique for the different types of reviews: reviews for describing, understanding, explaining, and theory testing. Transparency of the applied methodology is important for reviews that target theory testing, understanding, or explaining; similarly, reviews for describing, understanding or explaining achieve a higher impact when they develop a research agenda. By providing nuanced insights into the attributes of review papers that are valued by subsequent research, our study contributes to the vibrant discourse on literature reviews in IS. We thereby inform the different stakeholders involved in the development and publication of review papers in the IS field.

Keywords Review papers, scientometric, scientific impact, citation analysis

Explaining the Scientific Impact of Design Science Research

Title:	Exploring the Scientific Impact of Information Systems Design Science Research: A Scientometric Study
Authors:	Gerit Wagner, Julian Prester, and Guido Schryen
Status:	Published
Conference:	Thirty-Eighth International Conference on Information Systems (ICIS 2017)
Editors (Program Chairs):	Yong Jin Kim, Ritu Agarwal, and Jae Kyu Lee
Link	https://aisel.aisnet.org/icis2017/ResearchMethods/Presentations/8/

Abstract Design science is a fundamental research stream that contends its position in the information systems discipline. While ongoing debates address the relative importance of design science contributions in the information systems community, insights into the scientific impact of DSR are missing and this lack of understanding arguably poses challenges to an informed discourse. To identify the most influential papers and those factors that explain their scientific impact, this paper presents an exploratory study of the scientific impact of DSR papers published in the AIS Senior Scholars' Basket of Journals. We uncover the current DSR landscape by taking stock of influential papers and theories and develop a model to explain the scientific impact of DSR papers. Our findings show that scientific impact is significantly explained by theorization and novelty. We discuss how the implications of our work can be projected on the overarching discourse on DSR.

Keywords Design science research, scientometric, impact of research methods

Distinguishing the Scientific Impact of Review Articles

Title:	Classifying the Ideational Impact of IS Review Articles: A Natural Language Processing Based Approach
Authors:	Julian Prester, Gerit Wagner, and Guido Schryen
Status:	Published
Conference:	Thirty-Ninth International Conference on Information Systems (ICIS 2018)
Editors (Program Chairs):	Jan Pries-Heje, Sudha Ram, and Michael Rosemann
Link	https://aisel.aisnet.org/icis2018/research/ Presentations/1

Abstract By providing knowledge contributions and stimulating future research, RAs play a vital role for cumulative knowledge development. Although many papers cite RAs, it is rarely transparent to which degree citation impact represents perfunctory citations as opposed to a deeper engagement with a RAs knowledge contributions. This distinction between perfunctory and ideational impact has largely been neglected in the literature arguably because of the manual effort required for qualitative analysis. Against this background, our study aims at developing automated classifiers of ideational impact of IS RAs. We propose a machine learning model based on natural language processing to evaluate the feasibility of automated analyses. The evaluation results provide evidence for an effective and scalable classification approach that presents a reliable and reproducible solution to the ideational impact classification problem. We discuss implications for improving the capabilities of understanding how IS scholars build on their fields body of knowledge.

Keywords Ideational impact classification, citation content analysis, literature reviews, machine learning, natural language processing, impact of research methods

Distinguishing the Scientific Impact of Design Science Research

Title:	Information Systems Design Science Research and Cumulative Knowledge Development: An Exploratory Study
Authors:	Richard Schuster, Gerit Wagner, and Guido Schryen
Status:	Published
Conference:	Thirty-Ninth International Conference on Information Systems (ICIS 2018)
Editors (Program Chairs):	Jan Pries-Heje, Sudha Ram, and Michael Rosemann
Link	https://aisel.aisnet.org/icis2018/design/Presentations/3/

Abstract Contributing to cumulative knowledge development is a central goal in Information Systems design science research (IS-DSR). IS design theories (ISDTs) have been recognized as a particularly important building block for the accumulation of design-oriented knowledge. Yet, there are limited insights into how follow-up research builds on IS design theories in terms of testing and extending. To address these issues, we present results from the first empirical analysis of how ISDTs have been tested and extended within and beyond IS journals. Our qualitative analysis of papers citing ISDTs uncovers an alarming paucity of follow-up research that builds on these ISDTs. Specifically, the overall number of papers testing and extending any of the selected ISDTs ranges in the single digits. To propose an actionable path forward, we formulate four specific guidelines on how the IS(-DSR) community can facilitate the cumulative extension of the IS knowledge base.

Keywords Design science research, information systems design theory, qualitative citation content analysis, cumulative knowledge development, knowledge base, impact of research

Conclusions

While the papers included in this thesis have addressed individual research questions related to explaining and distinguishing the scientific impact of RAs and DSR, the purpose of the final chapter is to summarize and discuss these insights and contributions from a broader perspective. After outlining the contributions, the implications for research practice, and future research opportunities, the final section concludes this thesis. Limitations are discussed in the respective papers.

8.1 Research Contributions

This thesis contributes broadly to our understanding of scientific impact and cumulative knowledge development in IS by (1) explaining the scientific impact of RAs and DSR, and by (2) advancing the understanding of different types of scientific impact that RAs and DSR can have. I briefly discuss the main contributions of each paper (cf. Table 8.1 for a summary) and then describe how they contribute to the broader discourse in IS.

In Paper 1, I conceive types of knowledge contributions based on their degree of abstraction and codification. These two dimensions, which have implications for the methodological characteristics and presentation of corresponding knowledge building blocks, have heretofore not been combined in a model for analyzing research. These archetypal knowledge contributions are used to develop a taxonomy that classifies RAs according to their bundles of knowledge contributions. In addition, this paper contributes to developing the foundation of the remaining papers which draw on its conceptual distinction of knowledge types to distinguish types of scientific impact (Paper 4) and to develop paper-level factors explaining scientific impact (Paper 2). Despite focusing on a different type of paper (DSR), the influence of Paper 1 can also be recognized in Papers 3 and 5.

Papers 2 and 3 develop and test scientometric models of scientific impact with vastly different outcomes concerning paper level factors. These insights contribute to the literature on RAs and DSR, and show to which extent paper-level factors such as methodological transparency,

novelty, theorization, and the development of research agendas translate into scientific impact after controlling for influences related to the journal and the authors of the paper.

Papers 4 and 5, by distinguishing different types of scientific impact, address the latent suspicion that scientific impact includes substantial quantities of superficial citations. For RAs, Paper 4 provides machine learning classifiers that are capable of distinguishing ideational impact in an efficient and effective way. For DSR, Paper 5 uncovers that very few papers have actually engaged with theoretical DSR papers in a meaningful way and analyzes possible reasons contributing to this lack of follow-up research.

Foundation	<p>Paper 1</p> <p>Research goal:</p> <ul style="list-style-type: none"> • Understanding how RAs contribute to knowledge development <p>Methodology:</p> <ul style="list-style-type: none"> • Qualitative content analysis • Classification of RAs according to their knowledge contributions <p>Conceptual framework:</p> <ul style="list-style-type: none"> • Contributions as an interplay between abstraction and codification of knowledge <p>Key contribution:</p> <ul style="list-style-type: none"> • Knowledge-based taxonomy of RAs • Conceptual foundation for developing antecedents of scientific impact and distinguishing types of scientific impact 	
Review Articles	<p>Paper 2</p> <p>Research goal:</p> <ul style="list-style-type: none"> • Explaining scientific impact of RAs <p>Methodology:</p> <ul style="list-style-type: none"> • Scientometric regression (GLM) <p>Factors:</p> <ul style="list-style-type: none"> • Journal impact, author impact, etc. • Transparency • Research Agenda <p>Key contribution:</p> <ul style="list-style-type: none"> • Effects different for types of RA • Transparency and research agenda have effects on scientific impact of RAs 	<p>Paper 4</p> <p>Research goal:</p> <ul style="list-style-type: none"> • Distinguishing scientific impact of RAs <p>Methodology:</p> <ul style="list-style-type: none"> • Manual classification of papers citing RAs • Machine learning classification <p>Types of impact:</p> <ul style="list-style-type: none"> • Ideational vs. perfunctory impact <p>Key contribution:</p> <ul style="list-style-type: none"> • Automated capability (classifiers) • Classification performance on par with human coders
Design Science Research	<p>Paper 3</p> <p>Research goal:</p> <ul style="list-style-type: none"> • Explaining scientific impact of DSR <p>Methodology:</p> <ul style="list-style-type: none"> • Scientometric regression (GLM) <p>Factors :</p> <ul style="list-style-type: none"> • Journal impact, author impact, etc. • Novelty • Theorization <p>Key contribution:</p> <ul style="list-style-type: none"> • Novelty and theorization have an effect on scientific impact of DSR 	<p>Paper 5</p> <p>Research goal:</p> <ul style="list-style-type: none"> • Distinguishing scientific impact of DSR <p>Methodology:</p> <ul style="list-style-type: none"> • Manual classification of papers citing theoretical DSR <p>Types of impact:</p> <ul style="list-style-type: none"> • Theory testing, theory extension and perfunctory impact <p>Key contribution:</p> <ul style="list-style-type: none"> • Discovered an alarming paucity of follow-up testing and elaboration • Derived guidelines for future DSR

Fig. 8.1: Framework: Summary of Research Contributions

An underlying notion of the research included in this thesis is that it does not only enable different stakeholders to shape knowledge development in the IS discipline but that it also informs the discourse on RAs and DSR in IS. Concerning the discourse on RAs in IS, there are competing opinions on the importance of methodological rigor, or systematicity and transparency.

While one camp in this debate emphasizes that systematicity and transparency are critical to the trustworthiness of RAs (Paré et al., 2016; Templier and Paré, 2018), another camp claims that qualities of creativity and insightfulness are more important than, and in conflict with, systematicity (Boell and Cecez-Kecmanovic, 2015b; Leidner, 2018). In this regard, my analyses show that by transparently reporting their methodology, RAs achieve a higher scientific impact, which is considered as a measure of success in the discourse on RAs (Leidner, 2018; Paré et al., 2015; Rowe, 2014). This observation that transparent RAs are more impactful is robust regarding several alternative explanations. In particular, it applies to theoretical RAs, for which the importance of transparency has been debated (cf. Boell and Cecez-Kecmanovic, 2015b; Leidner, 2018). By providing substantial evidence my work makes a significant contribution to a major methodological debate that spans ten papers published in top IS-journals in the past five years alone (Boell and Cecez-Kecmanovic, 2015a, 2015b; Chiasson, 2015; Leidner, 2018; Oates, 2015; Paré et al., 2016; Rowe, 2014; Schultze, 2015; Templier and Paré, 2018; Watson, 2015) but has heretofore failed to systematically analyze how the central qualities are associated with a measure of success (e.g., citations).

In recent debates on DSR, I observe an increasing interest in the antecedent factors of scientific impact, which is best captured in Gregor and Hevner's (2013) MISQ paper "*Positioning and Presenting Design Science Research for Maximum Impact*". Within this discourse, Gregor and Hevner describe a divide between the *design-theory* camp (e.g., Gregor and Jones, 2007; Markus et al., 2002; Walls et al., 1992) and the *pragmatic-design* camp (e.g., Hevner et al., 2004; March and Smith, 1995) with both camps offering competing visions for what types of DSR should be developed in IS research. I contribute to this debate by providing evidence for the contention that design theory and novelty make DSR impactful.

My work further contributes to understanding the different types of impact, RAs and DSR can have, and enables the IS discipline to shape its (cumulative) knowledge contributions accordingly. To analyze the types of scientific impacts of RAs, including highly cited ones, I contribute to extant research by developing and evaluating machine learning classifiers. These classifiers advance previous research both in terms of classification reliability⁴² and scalability. With regard to DSR, I uncover an alarming paucity of follow-up research that tests and extends design theories. Despite a growing interest in the systematic accumulation of design oriented knowledge⁴³, this issue has received scant attention in previous literature. Beyond making this lack of follow-up research transparent, I provide specific guidelines on how the DSR community can improve its cumulative efforts. Overall, my work offers building blocks for a more nuanced discourse on the types of scientific impact RAs and DSR can have and how they can be fostered in the IS discipline.

⁴² Cf. Bornmann and Daniel (2008), who identify highly divergent results of scientometric studies analyzing types of scientific impact.

⁴³ The recent call for papers on "*Accumulation and Evolution of Knowledge in Design Science Research*" (2018) at the Journal of the Association for Information Systems is one example.

8.2 Research Practice

The goal of all papers is to inform different stakeholders involved in the development of RAs and DSR on the factors that explain scientific impact and types of scientific impact that should be distinguished. The implications I derive from my research align with the overarching value proposition of scientometric research, i.e., that “*with a deeper understanding of the factors behind successful science, we can enhance the prospects of science as a whole*” (Fortunato et al., 2018, p.1).

Prospective authors can draw on the models explaining scientific impact when developing their manuscripts. While antecedent factors at the journal and author level can rarely be influenced directly, knowing the effects of paper level factors, which are the focus of Papers 2 and 3, can provide useful guidance. Authors can draw on these insights on what makes RAs and DSR successful in terms of scientific impact both at the early stages of manuscript development and at the latter stages when they are confronted with time and page restrictions. For example, should the remaining days before a submission deadline be used to polish the methodology or future work section? Which sections should be expanded if page restrictions have not yet been exceeded or which parts of the manuscripts should be shortened in the opposite case? These decisions clearly depend on the type of manuscript that is developed and can pertain to various aspects related to methodology, degree of abstraction (theorization), novelty, and guidance for future research. Editors and reviewers should also refer to these aspects when assessing which manuscripts are likely to have a lasting impact on the field and to provide authors with feedback on how manuscripts can be improved in this regard.

Insights gained from distinguishing perfunctory and ideational impact can inform and shape research practice and evaluation. My research increases transparency of cumulative knowledge development which may be concealed by overall citation scores. It thereby enables research evaluation to proceed beyond aggregated citation impact and does not require the assumption that “*all citations are equal*” (Smith, 1981, p.89). By analyzing both instances in which cumulative knowledge development occurs and instances in which it does not, my research suggests how cumulative knowledge development could be facilitated. Specifically, papers should encourage future research, they should transparently describe their limitations, and provide knowledge in sufficiently generalizable, or theoretical forms, which makes it applicable in related contexts. Follow-up research should, in turn, be more explicit in describing how specifically it draws on and extends previous research. Overall, I hope that my analyses contribute to limiting the proliferation of low-impact research that does not meaningfully engage with the current knowledge base. Instead, I envision that progress towards higher proportions of ideational impact would strengthen the accumulating IS body of knowledge and ultimately provide more value to practitioner audiences.

8.3 Research Opportunities

Developing fundamental aspects of knowledge development and scientific impact for two prominent types of papers in IS, this thesis naturally uncovers opportunities for future research. I emphasize four of them.

First, by distinguishing different types of scientific impact, Papers 4 and 5 provide the building blocks for two use cases: improved research evaluation and literature search capabilities. With regard to research evaluation, I envision new metrics that are based on ideational impact, i.e., that align with knowledge creation and are less susceptible to biases of perfunctory citation practices. With regard to literature search capabilities, I contend that substantial improvements in the effectiveness of citation searches are possible if search capabilities draw on classifiers distinguishing ideational from perfunctory impact. Overall, these use cases could advance scientometric research from a science management tool dimension and a citation-search tool dimension (cf. Hassan and Loebbecke, 2017).

Second, after zooming in on the different types of scientific impact as part of the second research goal of this thesis, a next step would be to consider types of impact in explanatory models. Specifically, if the classifiers developed in Paper 4 can be shown to perform well beyond the IS-business value domain, it would be possible to consider facets of scientific impact as a dependent variable. A promising research design would regress existing factors on overall impact and ideational vs. perfunctory impact alternatively. To the best of my knowledge, this approach, which requires access to full-texts of all citing papers and broadly applicable machine learning classifiers, would be the first of its kind in the scientometric literature. Above all, it would advance knowledge on the factors that drive not overall citation scores but ideational impact, which is associated with knowledge development. Furthermore, insights into the factors that drive perfunctory impact may be equally interesting because they represent aspects the IS discipline, or its stakeholders within the process of knowledge development, may want to avoid.

Third, impact on practice is relevant for both RAs and DSR. For DSR, advances in understanding and measuring impact on practice may be beneficial for strengthening its value proposition. RAs are an essential channel for communicating scientific knowledge to a practitioner audience in many disciplines (Oates, 2011; Tranfield, Denyer, and Smart, 2003), but they rarely serve that purpose in IS. In fact, many RAs in my samples focus on research exclusively with only a minority of approx. 10% discussing implications for practice to a noteworthy extent. Since many IS scholars aspire to produce research that is relevant to practice and inform practitioners, future research and the IS community at large can draw on initial efforts (e.g., Oates, 2011) and further contribute to achieving this goal.

Finally, with RAs and DSR, this thesis has focused on two widely different types of papers. For example, the differences are evident in (order of magnitude) differences in scientific impact, practical impact, and methodological characteristics. Despite, or perhaps even because of these

differences, there might be opportunities for each type of paper to learn from the other. Future research could analyze how RAs and DSR can interact to foster knowledge development in the IS discipline. For example, RAs could be more attentive to synthesizing implications for design that arise from the review of extant literature (e.g., Kohli and Melville, 2019, who provide a rare example in IS literature). DSR authors, in turn, should reinforce their efforts to codify design knowledge in a way that facilitates research synthesis (cf. Denyer and Tranfield, 2006). Ultimately, I envision that these changes lead to RAs of specific design problems that would provide invaluable resources for IS practitioners.

8.4 Concluding Remarks

The papers included in this thesis support the IS discipline's quest for developing impactful papers. Adding to opinionated IS debates, they offer evidence resulting from systematic analyses of the literature. As a new building block for this discourse, they advance the IS discipline's understanding of how contested factors, such as theorization and methodological transparency (Papers 2 and 3), affect scientific impact for both RAs and DSR. The analyses improve current scientometric models and methods in several regards. Most notably, they add novel and important factors to the arsenal of scientometric impact models and implement a broad array of robustness checks (Paper 2). By advancing machine learning classifiers (Paper 4), I also suggest how types of scientific impact can be distinguished to see through the maze of perfunctory citations and appreciate those connections that reflect (cumulative) knowledge development. Furthermore, I offer new perspectives on knowledge development through RAs (Paper 1), and identify alarming challenges concerning the accumulation of knowledge on DSR (Paper 5).

Overall, this thesis makes its contribution to a more informed and nuanced debate on RAs and DSR in IS. Obviously, this work does not provide a recipe for turning any manuscript into a high-impact paper or for radically eliminating all perfunctory citations. Nevertheless, I hope that it provides prospective authors of RAs and DSR manuscripts with evidence on the characteristics whose development may increase chances of making a better impact that is valued by subsequent IS research.

References

- Avital, M., Mathiassen, L., and Schultze, U. (2017). Alternative Genres in Information Systems Research. *European Journal of Information Systems*, 26(3), 240–247.
- Barrios, M., Guilera, G., and Gómez-Benito, J. (2013). Impact and Structural Features of Meta-analytical Studies, Standard Articles and Reviews in Psychology: Similarities and Differences. *Journal of Informetrics*, 7(2), 478–486.
- Becker, J., and Niehaves, B. (2007). Epistemological Perspectives on IS Research: A Framework for Analysing and Systematizing Epistemological Assumptions. *Information Systems Journal*, 17(2), 197–214.
- Benbasat, I., and Weber, R. (1996). Research Commentary: Rethinking Diversity in Information Systems Research. *Information Systems Research*, 7(4), 389–399.
- Bergh, D. D., Perry, J., and Hanke, R. (2006). Some Predictors of SMJ Article Impact. *Strategic Management Journal*, 27(1), 81–100.
- Bernecker, S. (2010). *Memory: A Philosophical Study*. New York, USA: Oxford University Press.
- Boell, S. K., and Cecez-Kecmanovic, D. (2015a). Debating Systematic Literature Reviews (SLR) and their Ramifications for IS: A Rejoinder to Mike Chiasson, Briony Oates, Ulrike Schultze, and Richard Watson. *Journal of Information Technology*, 30(2), 188–193.
- Boell, S. K., and Cecez-Kecmanovic, D. (2015b). On Being "Systematic" in Literature Reviews in IS. *Journal of Information Technology*, 30(2), 161–173.
- Bollen, J., Van de Sompel, H., Hagberg, A., and Chute, R. (2009). A Principal Component Analysis of 39 Scientific Impact Measures. *PLOS ONE*, 4(6), 1–11.
- Bornmann, L., and Daniel, H.-D. (2008). What Do Citation Counts Measure? A Review of Studies on Citing Behavior. *Journal of Documentation*, 64(1), 45–80.
- Bornmann, L., Mutz, R., Hug, S. E., and Daniel, H.-D. (2011). A Multilevel Meta-Analysis of Studies Reporting Correlations between the H Index and 37 Different H Index Variants. *Journal of Informetrics*, 5(3), 346–359.
- Case, D. O., and Higgins, G. M. (2000). How Can We Investigate Citation Behavior? A Study of Reasons for Citing Literature in Communication. *Journal of the Association for*

- Information Science and Technology*, 51(7), 635–645.
- Chakraborty, T., Kumar, S., Goyal, P., Ganguly, N., and Mukherjee, A. (2014). Towards a Stratified Learning Approach to Predict Future Citation Counts. In G. Buchanan, A. MacFarlane, S. J. Cunningham, M. Klein, and A. Rauber (Eds.), *Proceedings of the 14th ACM/IEEE-CS Joint Conference on Digital Libraries* (pp. 351–360). September 8-12, London, United Kingdom: IEEE Press.
- Chalmers, A. F. (2013). *What is this Thing Called Science?* (4th ed.). Hackett Publishing.
- Chen, W., and Hirschheim, R. (2004). A Paradigmatic and Methodological Examination of Information Systems Research from 1991 to 2001. *Information Systems Journal*, 14(3), 197–235.
- Chiasson, M. W. (2015). Avoiding Methodological Overdose: A Declaration for Independent Ends. *Journal of Information Technology*, 30(2), 174–176.
- Codd, E. F. (1970). A Relational Model of Data for Large Shared Data Banks. *Communications of the ACM*, 13(6), 377–387.
- Colquitt, J. A., and Zapata-Phelan, C. P. (2007). Trends in Theory Building and Theory Testing: A Five-decade Study of the Academy of Management Journal. *Academy of Management Journal*, 50(6), 1281–1303.
- Cuellar, M. J., Vidgen, R., Takeda, H., and Truex, D. (2016). Ideational Influence, Connectedness, and Venue Representation: Making an Assessment of Scholarly Capital. *Journal of the Association for Information Systems*, 17(1), 1–28.
- Denyer, D., and Tranfield, D. (2006). Using Qualitative Research Synthesis to Build an Actionable Knowledge Base. *Management Decision*, 44(2), 213–227.
- Doyle, J. R., Arthurs, A. J., McAulay, L., and Osborne, P. G. (1996). Citation as Effortful Voting: A Reply to Ones, Brinn and Pendlebury. *Omega*, 24(5), 603–606.
- Edmondson, A. C., and McManus, S. E. (2007). Methodological Fit in Management Field Research. *Academy of Management Review*, 32(4), 1246–1264.
- Eysenbach, G. (2011). Can Tweets Predict Citations? Metrics of Social Impact based on Twitter and Correlation with Traditional Metrics of Scientific Impact. *Journal of Medical Internet Research*, 13(4).
- Fenner, M. (2014). Altmetrics and Other Novel Measures for Scientific Impact. In S. Bartling and S. Friesike (Eds.), *Opening Science* (pp. 179–189). Springer.
- Feyerabend, P. (1975). How to Defend Society against Science. *Radical Philosophy*(11), 3–8.
- Feyerabend, P. (1993). *Against Method* (3rd ed.). London: Verso.
- Fink, A. (2014). *Conducting Research Literature Reviews: From the Internet to Paper* (2nd ed.). London: Sage.
- Firth, D., and Lawrence, C. (2003). Genre Analysis in Information Systems Research. *Journal of Information Technology Theory and Application*, 5(3), 63–77.
- Fisher, G., and Aguinis, H. (2017). Using Theory Elaboration to Make Theoretical Advance-

- ments. *Organizational Research Methods*, 20(3), 438–464.
- Fortunato, S., Bergstrom, C. T., Börner, K., Evans, J. A., Helbing, D., Milojević, S., Petersen, A. M., Radicchi, F., Sinatra, R., Uzzi, B., Vespignani, A., Waltman, L., Wang, D., and Barabási, A.-L. (2018). Science of Science. *Science*, 359(6379), 1–7.
- Garfield, E. (1965). Can Citation Indexing be Automated. In M. E. Stevens (Ed.), *Statistical Association Methods for Mechanized Documentation, Symposium Proceedings* (pp. 189–192). March 17, Washington, DC.
- Garfield, E. (1996). When to Cite. *The Library Quarterly*, 66(4), 449–458.
- Gilbert, G. N. (1977). Referencing as Persuasion. *Social Studies of Science*, 7(1), 113–122.
- Greco, J., and Sosa, E. (1999). *The Blackwell Guide to Epistemology*. New York, USA: Wiley-Blackwell.
- Gregor, S. (2006). The Nature of Theory in Information Systems. *MIS Quarterly*, 30(3), 611–642.
- Gregor, S. (2009). Building Theory in the Sciences of the Artificial. In V. K. Vaishnavi and S. Purao (Eds.), *Proceedings of the 4th International Conference on Design Science Research in Information Systems and Technology* (pp. 1–10). May 7-8, Philadelphia, PA, USA: Association for Computing Machinery.
- Gregor, S., and Hevner, A. (2013). Positioning and Presenting Design Science Research for Maximum Impact. *MIS Quarterly*, 37(2), 337–356.
- Gregor, S., and Jones, D. (2007). The Anatomy of a Design Theory. *Journal of the Association for Information Systems*, 8(5), 312–335.
- Grover, V., Raman, R., and Stubblefield, A. (2013). What Affects Citation Counts in MIS Research Articles? An Empirical Investigation. *Communications of the Association for Information Systems*, 34, 1435–1456.
- Hansen, S., Lyytinen, K., and Markus, M. L. (2006). The Legacy of "Power and Politics" in Disciplinary Discourse: A Citation Analysis. In D. Straub and S. Klein (Eds.), *Proceedings of the 27th International Conference on Information Systems*. December 10-13, Milwaukee, WI, USA: Association for Information Systems.
- Harzing, A.-W. (2013). Document Categories in the ISI Web of Knowledge: Misunderstanding the Social Sciences? *Scientometrics*, 94(1), 23–34.
- Hassan, N. R., and Loebbecke, C. (2017). Engaging Scientometrics in Information Systems. *Journal of Information Technology*, 32(1), 85–109.
- Hevner, A. R., March, S. T., Park, J., and Ram, S. (2004). Design Science in Information Systems Research. *MIS Quarterly*, 28(1), 75–105.
- Hirsch, J. E. (2005). An Index to Quantify an Individual's Scientific Research Output. *Proceedings of the National Academy of Sciences of the United States of America*, 102(46), 16569–16572.
- Hoffmann, C. P., Lutz, C., and Meckel, M. (2016). A Relational Altmetric? Network Centrality

- on Research Gate as an Indicator of ScientificImpact. *Journal of the Association for Information Science and Technology*, 67(4), 765–775.
- Judge, T. A., Cable, D. M., Colbert, A. E., and Rynes, S. L. (2007). What Causes a Management Article to Be Cited – Article, Author, or Journal? *Academy of Management Journal*, 50(3), 491–506.
- Kaplan, A. (2017). *The Conduct of Inquiry: Methodology for Behavioural Science* (4th ed.). New Brunswick: Transaction Publishers.
- Keen, P. G. W. (1980). MIS Research: Reference Disciplines and a Cumulative Tradition. In M. L. Bariff (Ed.), *Proceedings of the 1st International Conference on Information Systems*. December 8-10, Philadelphia, PA, USA: Association for Information Systems.
- Ketcham, C. M., and Crawford, J. M. (2007). The Impact of Review Articles. *Laboratory Investigation*, 87(12), 1174–1185.
- Khazanchi, D., and Munkvold, B. E. (2000). Is Information System a Science? An Inquiry into the Nature of the Information Systems Discipline. *ACM SIGMIS Database*, 31(3), 24–42.
- King, D. A. (2004). The Scientific Impact of Nations. *Nature*, 430(6997), 311–316.
- Knorr Cetina, K. (1991). Merton’s Sociology of Science: The First and the Last Sociology of Science? *Contemporary Sociology*, 20(4), 522–526.
- Kohli, R., and Melville, N. P. (2019). Digital Innovation: A Review and Synthesis. *Information Systems Journal*, 29(1), 220–223.
- Kuhn, T. S. (1970). *The Structure of Scientific Revolutions* (2nd ed.). The University of Chicago Press.
- Landry, M., and Banville, C. (1992). A Disciplined Methodological Pluralism for MIS Research. *Accounting, Management and Information Technologies*, 2(2), 77–97.
- Langley, A. (2010). The Challenge of Developing Cumulative Knowledge about Strategy as Practice. In D. Golsorkhi, L. Rouleau, D. Seidl, and E. Vaara (Eds.), *Cambridge Handbook of Strategy as Practice* (pp. 91–108). Cambridge University Press Cambridge.
- Leidner, D. E. (2018). Review and Theory Symbiosis: An Introspective Retrospective. *Journal of the Association for Information Systems*, 19(6), 552–567.
- Leydesdorff, L. (1998). Theories of Citation? *Scientometrics*, 43(1), 5–25.
- March, S. T., and Smith, G. F. (1995). Design and Natural Science Research on Information Technology. *Decision Support Systems*, 15(4), 251–266.
- Markus, M. L., Majchrzak, A., and Gasser, L. (2002). A Design Theory for Systems that Support Emergent Knowledge Processes. *MIS Quarterly*, 26(3), 179–212.
- May, R. M. (1997). The Scientific Wealth of Nations. *Science*, 275(5301), 793–796.
- McCain, K. W., and Salvucci, L. J. (2006). How Influential is Brooks Law? A Longitudinal Citation Context Analysis of Frederick Brooks the Mythical Man-month. *Journal of Information Science*, 32(3), 277–295.
- McKeown, K., Daume, H. I. I. I., Chaturvedi, S., Paparrizos, J., Thadani, K., Barrio, P., Biran,

- O., Bothe, S., Collins, M., Fleischmann, K. R., Gravano, L., Jha, R., King, B., McInerney, K., Moon, T., Neelakantan, A., O'Seaghdha, D., Radev, D., Templeton, C., and Simone, T. (2016). Predicting the Impact of Scientific Concepts Using Full-text Features. *Journal of the Association for Information Science and Technology*, 67(11), 2684–2696.
- Merton, R. K. (1973). *The Sociology of Science: Theoretical and Empirical Investigations* (N. W. Storer, Ed.). Chicago: University Of Chicago Press.
- Merton, R. K. (1988). The Matthew Effect in Science, ii: Cumulative Advantage and the Symbolism of Intellectual Property. *Isis*, 79(4), 606–623.
- Mingers, J., and Xu, F. (2010). The Drivers of Citations in Management Science Journals. *European Journal of Operational Research*, 205(2), 422–430.
- Moed, H. F., and Garfield, E. (2004). In Basic Science the Percentage of Authoritative References Decreases as Bibliographies become Shorter. *Scientometrics*, 60(3), 295–303.
- Moravcsik, M. J., and Murugesan, P. (1975). Some Results on the Function and Quality of Citations. *Social Studies of Science*, 5(1), 86–92.
- Myers, M. D., and Venable, J. R. (2014, September). A Set of Ethical Principles for Design Science Research in Information Systems. *Information & Management*, 51(6), 801–809.
- Niederman, F., and March, S. T. (2012). Design Science and the Accumulation of Knowledge in the Information Systems Discipline. *ACM Transactions on Management Information Systems*, 3(1), 11–115.
- Oates, B. J. (2011). Evidence-Based Information Systems: A Decade Later. In V. K. Tuunainen, M. Rossi, and J. Nandhakumar (Eds.), *Proceedings of the 19th European Conference on Information Systems*. June 9-11, Helsinki, Finland: Association for Information Systems.
- Oates, B. J. (2015). On Systematic Reviews for Evidence-based Practice. *Journal of Information Technology*, 30(2), 177–179.
- Okoli, C. (2015). A Guide to Conducting a Standalone Systematic Literature Review. *Communications of the Association for Information Systems*, 37(1), 879–910.
- Paré, G., Tate, M., Johnstone, D., and Kitsiou, S. (2016). Contextualizing the Twin Concepts of Systematicity and Transparency in Information Systems Literature Reviews. *European Journal of Information Systems*, 25(6), 493–508.
- Paré, G., Trudel, M.-C., Jaana, M., and Kitsiou, S. (2015). Synthesizing Information Systems Knowledge: A Typology of Literature Reviews. *Information & Management*, 52(2), 183–199.
- Peppers, K., Tuunainen, T., Rothenberger, M. A., and Chatterjee, S. (2007). A Design Science Research Methodology for Information Systems Research. *Journal of Management Information Systems*, 24(3), 45–77.
- Popper, K. R. (2014). *Conjectures and Refutations: The Growth of Scientific Knowledge* (3rd ed.). London: Routledge Classics.
- Price, D. J. d. S. (1965). Networks of Scientific Papers. *Science*, 149(3683), 510–511.

- Rivard, S. (2014). Editor's Comments: The Ions of Theory Construction. *MIS Quarterly*, 38(2), iii–xiv.
- Rowe, F. (2014). What Literature Review is Not: Diversity, Boundaries and Recommendations. *European Journal of Information Systems*, 23(3), 241–255.
- Schultze, U. (2015). Skirting SLR's Language Trap: Reframing the 'Systematic' vs 'Traditional' Literature Review Opposition as a Continuum. *Journal of Information Technology*, 30(2), 180–184.
- Seglen, P. O. (1992). The Skewness of Science. *Journal of the American Society for Information Science*, 43(9), 628–638.
- Shadish, W. R., Tolliver, D., Gray, M., and Gupta, S. K. S. (1995). Author Judgements about Works They Cite: Three Studies from Psychology Journals. *Social Studies of Science*, 25(3), 477–498.
- Simon, H. A. (1969). *The Sciences of the Artificial*. The MIT Press.
- Small, H. G. (1978). Cited Documents as Concept Symbols. *Social Studies of Science*, 8(3), 327–340.
- Small, H. G. (2004). On the Shoulders of Robert Merton: Towards a Normative Theory of Citation. *Scientometrics*, 60(1), 71–79.
- Smith, L. C. (1981). Citation Analysis. *Library Trends*, 30(1), 83–106.
- Sternberg, R. J., and Gordeeva, T. (1996). The Anatomy of Impact: What Makes an Article Influential? *Psychological Science*, 7(2), 69–75.
- Straub, D. W. (2008). Editor's Comments: Type II Reviewing Errors and the Search for Exciting Papers. *MIS Quarterly*, 32(2), v–x.
- Stremersch, S., Verniers, I., and Verhoef, P. C. (2007). The Quest for Citations: Drivers of Article Impact. *Journal of Marketing*, 71(3), 171–193.
- Tahamtan, I., Afshar, A. S., and Ahamdzadeh, K. (2016). Factors Affecting Number of Citations: A Comprehensive Review of the Literature. *Scientometrics*, 107(3), 1195–1225.
- Takeda, H., Cuellar, M., Truex, D., and Vidgen, R. (2011). Networks of Innovation in IS Research: An Exploration of the Relationship between Co-authorship Networks and H-family Indices. In V. K. Tuunainen, M. Rossi, and J. Nandhakumar (Eds.), *Proceedings of the 19th European Conference on Information Systems*. June 9-11, Helsinki, Finland: Association for Information Systems.
- Tams, S., and Grover, V. (2010). The Effect of an IS Article's Structure on its Impact. *Communications of the Association for Information Systems*, 27, 149–172.
- Templier, M., and Paré, G. (2018). Transparency in Literature Reviews: An Assessment of Reporting Practices across Review Types and Genres in Top IS Journals. *European Journal of Information Systems*, 27(5), 503–550.
- Teufel, S., Siddharthan, A., and Tidhar, D. (2006). Automatic Classification of Citation Function. In D. Jurafsky and E. Gaussier (Eds.), *Proceedings of the 2006 Conference on Empir-*

- ical Methods in Natural Language Processing* (pp. 103–110). July 22-23, Sydney, Australia: Association for Computational Linguistics.
- Thornley, C., Watkinson, A., Nicholas, D., Volentine, R., Jamali, H. R., Herman, E., Allard, S., Levine, K. J., and Tenopir, C. (2015). The Role of Trust and Authority in the Citation Behaviour of Researchers. *Information Research*, 20(3), 1–19.
- Tranfield, D., Denyer, D., and Smart, P. (2003). Towards a Methodology for Developing Evidence-informed Management Knowledge by Means of Systematic Review. *British Journal of Management*, 14(3), 207–222.
- Truex, D., Cuellar, M., and Takeda, H. (2009). Assessing Scholarly Influence: Using the Hirsch Indices to Reframe the Discourse. *Journal of the Association for Information Systems*, 10(7), 560–594.
- Uzzi, B., Mukherjee, S., Stringer, M., and Jones, B. (2013). Atypical Combinations and Scientific Impact. *Science*, 342(6157), 468–472.
- Van Noorden, R. (2017). The Science That's Never Been Cited. *Nature*, 552(7684), 162–164.
- Walls, J. G., Widmeyer, G. R., and El Sawy, O. A. (1992). Building an Information System Design Theory for Vigilant EIS. *Information Systems Research*, 3(1), 36–59.
- Watson, R. T. (2015). Beyond Being Systematic in Literature Reviews in IS. *Journal of Information Technology*, 30(2), 185–187.
- Weber, R. (1987). Toward a Theory of Artifacts: A Paradigmatic Base for Information Systems Research. *Journal of Information Systems*, 1(2), 3–19.
- Webster, J., and Watson, R. T. (2002). Analyzing the Past to Prepare for the Future: Writing a Literature Review. *MIS Quarterly*, 26(2), xiii–xxiii.
- Winter, R. (2008). Design Science Research in Europe. *European Journal of Information Systems*, 17(5), 470–475.

Appendices

Further Papers

The following papers have been developed during the development of my thesis. They are not, however, part of it:

- **Heinrich, B., Klier, M., Schiller, A., Wagner, G.** 2018 Assessing Data Quality A Probability-based Metric for Semantic Consistency, in *Decision Support Systems*, 110, 95-106.
- **Schryen, G., Wagner, G., Benlian, A.** Distinguishing Knowledge Impact from Citation Impact: A Methodology for Analysing Knowledge Impact for the Literature Review Genre, Under Review at the *Scandinavian Journal of Information Systems*.
- **Schryen, G., Wagner, G., Benlian, A., and Paré, G.** A Knowledge Development Perspective on Literature Reviews: Validation of a New Typology in the IS Field, Under Review at the *Communications of the Association for Information Systems*.
- **Schryen, G., Wagner, G., Schlegel, A.** 2016. Development of Two Novel Face-recognition CAPTCHAs: A Security and Usability Study, in *Computers & Security*, 60, 95-116.
- **Schryen, G., Benlian, A., Rowe, F., Gregor, S., Larsen, K., Petter, S., Paré, G., Wagner, G., Haag, S., Yasasin, E.** 2017. Literature Reviews in IS Research: What Can Be Learnt from the Past and Other Fields?, in *Communications of the Association for Information Systems*, 41 (Paper 30), 759-774.
- **Wagner, G., Empl, P., and Schryen, G.** Designing a Novel Strategy for Reading and Skimming Literature Corpora, Working Paper.
- **Wagner, G., Prester, J., Roche, M., Benlian, A., and Schryen, G.** 2016. Factors Affecting the Scientific Impact of Literature Reviews: A Scientometric Study, in Ågerfalk, P. J., Levina, N., and Kien, S. S., editors, *Proceedings of the 37th International Conference on Information Systems*, pages 1-24, December 11-14, Dublin, Ireland. Association for Information Systems.

- **Weißhäupl, E., Kunz, M., Yasasin, E., Wagner, G., Prester, J., Schryen, G., Pernul, G.** 2015. Towards an Economic Approach to Identity and Access Management Systems Using Decision Theory, in Pernul, G., Schryen, G., and Schillinger, R., editors, *Proceedings of the Second International Workshop on Security in Highly Connected IT Systems*, pages 1-5, September 21-22, Vienna, Austria. FORSEC Research Association.
- **Yasasin, E., Prester, J., Wagner, G., and Schryen, G.** Forecasting IT Security Vulnerabilities - An Empirical Analysis, Under Review at *Computers & Security*.