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Abstract:

The accumulation of scientific knowledge is an important objective of information systems (IS) research. Although different review approaches exist in the continuum between narrative reviews and meta-analyses, most reviews in IS are narrative or descriptive—with all related drawbacks concerning objectivity and reliability—because available underlying sources in IS do typically not fulfil the requirements of formal approaches such as meta-analyses. To discuss how cumulative IS research can be effectively advanced using a more formalized approach fitting the current situation in IS research, in this paper, we point out the potential of stylized facts (SFs). SFs are interesting, sometimes counterintuitive patterns in empirical data that focus on the most relevant aspects of observable phenomena by abstracting from details (stylization). SFs originate from the field of economics and have been successfully used in different fields of research for years. In this paper, we discuss their potential and challenges for literature reviews in IS. We supplement our argumentation with an application example reporting our experience with SFs. Because SFs show considerable potential for cumulative research, they seem to be a promising instrument for literature reviews and especially for theory development in IS.

Keywords: Stylized Facts, Literature Review, Research Synthesis, Cumulative Research, Theory Development.

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1 Introduction

Based on the growing research efforts and the increasing amount of publications in the information systems (IS) field, literature reviews have been gaining more and more importance (Webster & Watson, 2002). Literature reviews can have different goals and serve different purposes (Cooper, 1998) such as summarizing the state of the art in a field of research, integrating existing scientific knowledge to develop theory, discovering innovative knowledge, identifying open issues, and developing research agendas or criticising existing research streams. Hence, literature reviews can fulfil important tasks in research processes and can, furthermore, produce meaningful research results themselves (Wolfswinkel, Furtmueller, & Wilderom, 2013).

In general, we can distinguish different methods and systematic approaches for performing literature reviews that serve the above mentioned goals and purposes (Booth, Papaioannou, & Sutton, 2012). Literature review approaches in IS research typically range between narrative reviews (qualitative), which generally lead to rather subjective results with a comparatively low amount of reproducibility, and more formalized and systematic approaches for meta-analysis (quantitative), which are considered the most reliable and "objective" review method (Guzzo, Jackson, & Katzell, 1987; King & He, 2005). Because there are no methodical or formal requirements concerning underlying data material, narrative reviews offer the possibility of easily summarizing IS studies' results that are based on different research methods. In contrast, meta-analyses have strictly defined methodical requirements. Although several exceptions can be found in IS research (Alavi & Joachimsthaler, 1992; Benbasat & Lim, 1993; King & He, 2006; Kohli & Devaraj, 2003; Yousafzai, Foxall, & Pallister, 2007), few topics of interest to IS can offer adequate data material to conduct a meta-analysis so far. The fact that a major amount of documented results in IS research—as a relatively young field—does not fulfill the necessary formal and methodical requirements for meta-analyses can be regarded one important reason why many published literature reviews in IS are narrative reviews with all the common drawbacks concerning the subjectivity of obtained results. However, even other available literature review approaches such as descriptive review or vote counting (King & He, 2005) can cure this problem only to a certain extent because they either have specific methodical requirements or tend to be rather subjective, too. Hence, there is a trade-off situation in IS research between "rather subjective but broadly supported" results based on narrative reviews on the one side and "objective but rather restricted" results based on meta-analysis on the other side of the continuum of common review approaches.

While conducting literature reviews in IS (LRiIS) is undoubtedly a highly important endeavor, available methodical approaches have difficulties solving the problems arising from the above-mentioned particular characteristics of IS research regarding the availability and form of results. To state the problem frankly and in a nutshell, based on the lack of standardized and adequate empirical data material in IS, many literature reviews in IS use narrative or descriptive review approaches and, thus, lack objectivity and reliability.

To help solve this problem and to take part in the ongoing discussion regarding how cumulative IS research can be advanced by means of literature reviews, we point out the potential of the concept of stylized facts (SFs), which originates from economic research (Kaldor, 1961). SFs are interesting patterns in empirical data (empirical generalizations, accumulations of evidence) that focus on the most relevant aspects of observable phenomena by abstracting from details (stylization). SFs are not necessarily valid in every situation or context and they do not aim to represent causal relationships but rather interesting correlations (Heine, Meyer, & Strangfeld, 2005; Helfat, 2007). SFs are typically developed by means of a structured review of the literature, and adequate review approaches for developing SFs are currently being investigated (Houy, Fettke, & Loos, 2013). SFs can give a new perspective on the above-described problems of literature reviews in IS research and can, furthermore, help to develop a more consolidated view on available research results, even on inconsistent and contradictory empirical findings.

SFs have been successfully used for years in different fields of research, especially in economics. Furthermore, SF usage in different research fields is growing. Figure 1 overviews the development of the number of papers using SFs, which we retrieved from the literature database SCOPUS (search term: "stylized facts" in title, abstract, and keywords; 1871 papers in February 2014). In this set of papers using SFs, most contributions stem from economics and finance (about 43%). However, a large number of these papers are concerned with other fields of research such as computer science, mathematics, physics, engineering, environmental sciences, chemistry, arts and humanities, or psychology. From this, it

follows that SFs are applicable in many different fields of research and could, thus, also offer interesting potential for IS research (Houy et al., 2013).

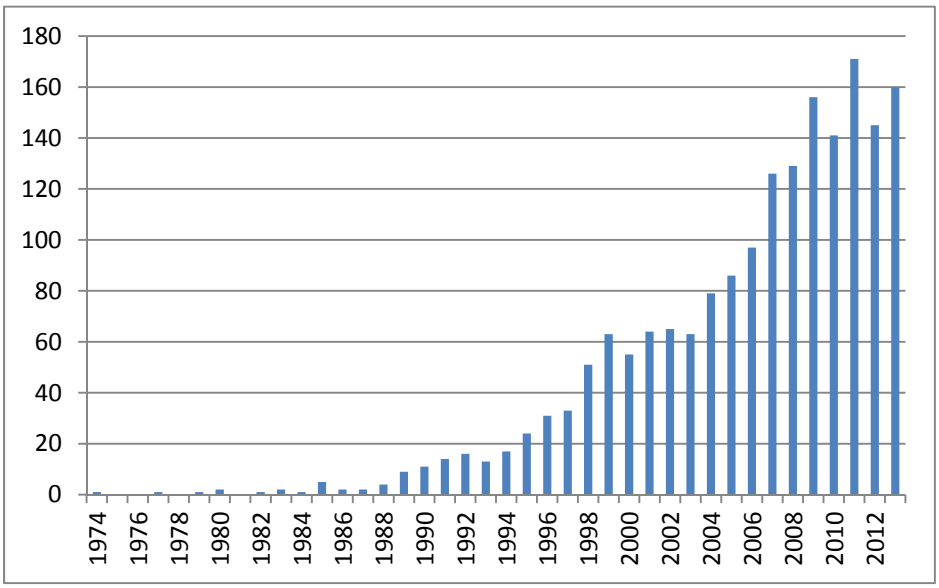

Figure 1. Development of the Usage of Stylized Facts in SCOPUS

Besides that, SFs' role in IS research and IS engineering was discussed in a panel documented in the journal *Business and Information Systems Engineering (BISE)*. According to this panel discussion, SFs can play a significant role and offer considerable potential for cumulative research, especially for developing IS theories and for IS fundamental research based on literature reviews (Loos et al., 2011). In this panel, Stephan Zelewski pointed out several interesting phenomena that can be regarded as SFs and that are relevant for IS research (e.g., the productivity paradox of information technology) (Brynjolfsson, 1993) or the bullwhip effect (Lee, Padmanabhan, & Whang, 1997) in supply chain management (SCM) (Houy et al., 2013; Loos et al., 2011). These SFs belong to fundamental problem domains of IS and deserve to be further investigated to improve the understanding of fundamental principles concerning IS usage (Houy et al., 2013). However, few applications of SFs to IS research exists (e.g., in Houy, Fettke, & Loos, 2009; Fettke, Houy, & Loos, 2010a; Houy, Fettke, & Loos, 2011b; Reiter, Fettke, & Loos, 2013).

Against this background, in this paper, we investigate and discuss SFs' potential for literature reviews in IS, especially in the context of theory development and cumulative IS research in general. We argue that SFs can significantly contribute to theory development. Empirical regularities and broadly supported knowledge can serve as a starting point for new theories and to further develop existing ones.

More specifically, we address the following research questions:

RQ1: How can SFs support literature reviews for cumulative research in IS?

RQ2: What potential do SFs have and what are their requirements and challenges in the context of IS research?

RQ3: What are SFs' potential for theory building and development?

The research approach we use in this paper is based on conceptual consideration and a profound analysis (Sloman, 1978) of the SF concept. We supplement our argumentation by presenting an operationalized method for developing and using SFs in IS research. To illustrate our developed approach, we present several application scenarios and our experience in using SFs in the context of IS research. We critically reflect on and discuss outcomes and implications.

The paper's structure is as follows: in Section 2, we introduce the SF concept in more detail and, in Section 3, compare it to other literature review approaches. In Section 4, we discuss SFs' advantages in particular situations occurring in IS research and illustrate their usefulness for literature reviews in more detail. Thereafter, in Section 5, we discuss SFs' potential for building and developing theory, and, in Section 6, we present an operationalized approach for developing and using SFs. In Section 7, we present and discuss the results of an exemplary application of this approach for theory building in the

context of the process modeling technique event-driven process chains (EPC). Finally, in Section 8, we discuss SFs' potential and the challenges and their implications for IS in general, and, in Section 9, we conclude the paper.

2 The Concept of Stylized Facts

Stylized facts (SFs) constitute knowledge in the form of generalized and simplified statements describing interesting characteristics and relationships concerning empirically observable phenomena (Heine et al., 2005; Helfat, 2007). SFs can be conceptualized as interesting, sometimes counterintuitive, patterns in empirical data (empirical generalizations, accumulations of evidence) documented in different sources. An important characteristic of SFs is their focus on the most relevant aspects of observable phenomena by abstracting from details (stylization). Thus, SFs are broadly supported and simplified representations of complex relationships that are not necessarily valid in every situation and context (Heine, Meyer, & Strangfeld, 2007; Houy, Fettke, & Loos, 2009, 2011b; Houy et al., 2013). SFs do not aim to represent causal relationships but rather interesting correlations that are observable in reality. Thus, reducing the complexity of real-world phenomena, SFs can—according to Stephan Zelewski—serve as "a 'seed of crystallization' for the construction and critical review of models or theories" (Loos et al., 2011). Kaldor (1961) introduced the SF concept in the context of macroeconomic growth theory to compare the explanatory power of existing economic models and support the development of new theoretical models that should be able to explain empirically observable phenomena.

Exemplary SFs in the field of economics are the Phillips curve (Phillips, 1958), which describes the empirically broadly supported relationship between changes in nominal wages and unemployment in an economy (Helfat, 2007) or the commonly accepted positive relationship between education and lifetime earnings. However, as mentioned before, SFs may not be true in every situation (Heine et al., 2007; Houy et al., 2009, 2011b) (e.g., lifetime earnings may even be lower when a person has invested a lot of time in completing a PhD and has worked in Academia)[1]. Figure 2 conceptualizes SFs: it considers their most important characteristics and uses the aforementioned example concerning the relationship between education and lifetime earnings.

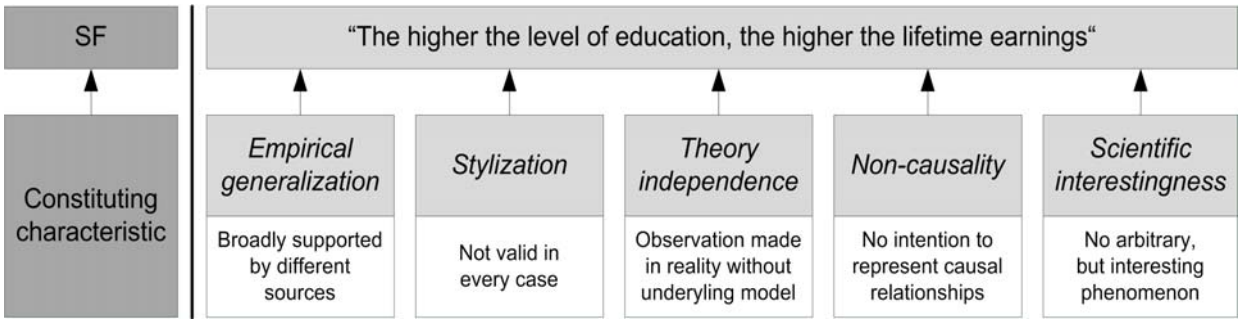

Figure 2. Conceptualization of Stylized Facts via an Example

Against this background, note that, in contrast to "classical" hypotheses—which typically represent preliminary claims in the context of the deductive discovery of scientific laws and still have a vague character—SFs are statements that have already been confirmed in a certain number of cases, preferably in empirical studies using different methods (triangulation of methods) (Houy et al., 2011b).

A further important difference between SFs and scientific laws or hypotheses—as the central elements of theories—is that SFs represent simplified statements about phenomena observable in reality that are independent of any theory. Hence, SFs can serve as a counterpoint to the typical way of deductively developing theories. Deductive theory development can indeed be "counterproductive, particularly if it leads us to look under the lamppost because that is where there is light" instead of studying phenomena "that may be as or even more important" (Helfat, 2007). Against this background, SFs can help researchers to identify new and unexplained empirical phenomena and anomalies that contradict current theory. SFs can, thus, support an inductive development of theory in a bottom up manner. Figure 3 compares SFs and scientific laws according to the categories of the above conceptualization.

[1] For more typical counterexample concerning well-known SFs, see e.g. http://en.wikipedia.org/wiki/Stylized_fact, accessed on: 30th September 2014.

	Stylized facts	Scientific laws
General nature	Generalized statements abstracting from details	Detailed statements about generally valid principles
Validity	Not necessarily valid in every context and under every condition (Stylization)	Valid in well-defined contexts
Dependence on theory	Independent of theory	Important parts of dedicated scientific theories
Relationship towards causality	No intention to represent causal relationships	Implying causal relationships
Scientific interrestingness	High	High

Figure 3. Stylized facts vs. Scientific laws

As for this conceptualization, SFs can be considered a sub-class of empirical generalizations. An empirical generalization is typically "an isolated proposition summarizing observed uniformities of relationships between two or more variables" (Merton, 1968). However, SFs do not claim to consolidate absolutely identical empirical results ("uniformities"). In contrast, they abstract from details (stylization) and bring together similar results pointing at an interesting phenomenon. SFs have sometimes been criticized for:

> *not really being "facts", but [they] are better than any ad hoc collection of individual facts. For example, a regression equation is a stylized fact that tells us something about all the facts in a sample that cannot be found within any of the individual facts. Indeed, the regression prediction is inaccurate with respect to every single one of them. (Snidal, 2008)*

Snidal's useful picture helps us to further illustrate SFs' nature. Figure 4 visualizes this comparison in which the regression equation symbolizes a SF. Although none of the given data points really falls on the regression line, it accurately expresses the overall relationship.

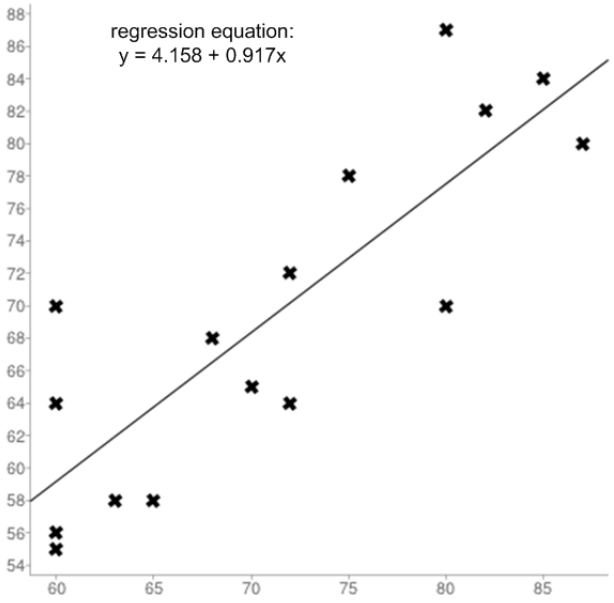

Figure 4. Exemplary Regression Equation Illustrates Stylized Facts' Nature

Typically, SFs are developed by grouping, generalizing, and aggregating similar empirical observations from different, systematically retrieved sources. Thereby, concentrated knowledge about characteristics and properties of an object or phenomenon is created. As mentioned above, SFs should preferably be developed based on a certain amount of different studies (Heine et al., 2007; Houy et al., 2009, 2011b). The generated SFs can be considered even more valuable if empirical results from studies with different

underlying (qualitative and quantitative) research methods were used because triangulating methods is generally considered to improve research results' validity (Denzin, 1989; Houy et al., 2011b).

We provide a more detailed operationalization of the process of developing SFs in Section 6. However, at this point, note that, during this process, all relevant statements containing observations on the topic of interest are gathered while particular underlying theories or particular research paradigms are not of interest. Hence, SFs are typically developed without taking a particular theoretical perspective on a topic. Researchers should use this approach to formulate SFs on the basis of mere empirical observations independent of any theory and independent of any research paradigm. As such, SFs can later serve to compare different theories regarding the following question (Kaldor, 1961): which theory can better explain or reproduce the formulated SFs? Against this background, SFs refrain from taking the perspective of one particular theory but focus on empirical observations. Thus, SFs can also support research in the field of philosophy of science, which aims to compare theories and research paradigms. In Section 3, we compare the SF concept and common approaches for literature review in IS research.

3 Comparing Stylized Facts with Other Review Approaches

To differentiate SFs from other common approaches for IS research synthesis based on literature reviews, we can classify SFs as being somewhere in the middle of the spectrum of common qualitative and quantitative IS research synthesis methods ranging from narrative review (qualitative end of the spectrum) to meta-analysis (quantitative end of the spectrum) (King & He, 2005).

In comparing review approaches, we consider typical approaches for research synthesis (Cooper & Hedges, 1994) that are used in IS research and have been described in Guzzo et al. (1987) and King and He (2005): narrative review, descriptive review, vote counting, meta-analysis and, furthermore, a very recent approach for literature reviews based on the idea of grounded theory (Wolfswinkel et al., 2013), which can be used for theory building (Glaser & Strauss, 1967). We analyze and compare these approaches based on: 1) their general definition and expectable results of their application, (2) the prerequisites concerning the data used, and (3) the methods' methodical and theoretical characteristics. In Tables 1-3, the ascending order of approaches expresses an increasing degree of formalization from 1) narrative review to 6) meta-analysis.

Table 1. General Definition and Expectable Results

	General definition	Typical goals	Structuredness of results	Reproducibility of results	Objectivity of results
1. Narrative review referring to (King & He, 2005, p. 667)	"Verbal description of past studies"; "no commonly accepted or standardized procedure".	Heuristic value, postulation, and advancement of theories and models; examination of important and controversial topics.	Verbal descriptions are typical; freedom of framing the outcomes.	Comparatively low reproducibility due to subjective decisions and point of view.	Comparatively low objectivity due to many subjective decisions and judgments during the review process.
2. Descriptive review referring to (King & He, 2005, p. 667; (Guzzo et al., 1987)	Literature review approach introducing quantitative aspects in order to propose and present "inter-pretable patterns" in a population of papers.	Frequency analysis, trend analysis, cluster analysis, represent the "state of research in a domain".	Results are commonly structured according to quantitatively investigated characteristics and features; freedom of framing the outcomes to a certain extent.	As far as quantitative results are concerned, the reproducibility of results should be high as there is not much room for interpretation; depends on the underlying features and characteristics.	Regarding quantitative results, the objectivity of results should be high as there is not much room for subjectivity; depends on the underlying features and characteristics.

Table 1. General Definition and Expectable Results

3. Grounded theory literature review method (Wolfswinkel et al., 2013)	"Approach for a literature review that invokes grounded theory as a method during the analysis stage" (p. 47).	"In-depth analysis of empirical facts" for "more integrated and fruitful theory emergence" (abstract).	Depending on the results in the underlying literature and on the coding process (open, axial and selective coding).	Medium reproducibility; subjective decisions vs. structured development process and reliability checks.	Medium; subjective decisions; high transparency of the coding process through documentation.
4. Stylized facts	Approach to identify broadly supported phenomena and relationships focusing on the relevant characteristics of a phenomenon.	Identification of stable correlations; theory building, theory testing and comparison using SFs as language-based artefacts.	Depending on the results in the underlying literature and the developed SFs.	Medium reproducibility; subjective decisions vs. structured and transparent development process and reliability checks.	Medium; subjective decisions; high transparency of the development of SFs; several stages of abstracting the results are documented.
5. Vote counting[2] referring to (King & He, 2005, p. 667)	Literature review approach which aims at identifying patterns in empirical data by combining results of different individual studies.	Identification of stable correlations; underlying philosophy: higher value of "repeated results in the same direction across multiple studies" compared to one study.	Results are commonly structured according to the investigated relationships / correlations.	As far as the direction and significance of relationships / correlations are investigated, the reproducibility of results should be high as there is not much room for interpretation.	Concerning the investigation of the direction and significance of relationships / correlations are investigated; there is not much room for subjectivity.
6. Meta-analysis referring to (King & He, 2005, p. 668)	Statistical synthesis method; "combining and analyzing the quantitative results of many empirical studies".	"The analysis of analyses"; precisely calculated correlations, effect sizes and significances concerning a phenomenon based on many studies.	Results are structured according to the investigated correlations, significances, effect sizes and are thus comparatively highly structured.	High reproducibility of results as there is no room for interpretation.	Relatively high objectivity; no room for subjective interpretation.

[2] Sometimes "vote counting" is considered a "meta-analytic" approach considering effect sizes (e.g., in Rosenthal,(1991)). In contrast, other researchers do not consider effect sizes in "vote counting" but only information such as probabilities, p-levels, or information on the effect significance (yes/no, positive/negative), which are then aggregated (Guzzo et al., 1987; King & He, 2005).

Table 2. Prerequisites Concerning the Data Used (Informed by King & He, 2005)

	Specificity of data	Standardization of data	Underlying measurement methods
1. Narrative review (King & He, 2005, p. 667)	No specific prerequisite.	No specific prerequisite.	No specific prerequisite.
2. Descriptive review (King & He, 2005, p. 667)	In general, no specific pre-requisite when "some quantification" such as frequency analysis or trend analysis is used; specific "meta-data" (e.g., publication time, publication outlet) have to be accessible.	In general no specific prerequisite; if papers shall be coded regarding any characteristics, there has to be comparable feature presentation in place.	In general, no specific prerequisite; if papers shall be coded regarding any characteristics, the presented features should have been classified / measured with comparable classification / measurement instruments.
3. Grounded theory literature review method (Wolfswinkel et al., 2013)	No specific prerequisite; empirical results are of special value.	No specific prerequisite; data are made accessible by open, axial, and selective coding.	No specific prerequisite.
4. Stylized facts	No specific prerequisite; empirical results are of special value.	No specific prerequisite; SFs are developed in a transparent coding process.	No specific prerequisite; triangulation of methods is expected to improve the outcome.
5. Vote counting (King & He, 2005, p. 667)	Depending on the understanding of "vote counting", the data has some prerequisites. If inferences about focal relationships shall be drawn, the underlying data has to offer analyses on certain relationships / correlations etc.	Data of individual research contributions has to treat the same topic (homogeneous content); data has to present relationships or correlations depending on the understanding of "vote counting"; certain standard data value types are needed such as probabilities, p-levels, or information on the effect significance (yes / no, positive / negative).	Depending on the understanding of "vote counting", the underlying measurement methods and instruments have to be able to produce the mentioned data value types needed.
6. Meta-analysis (King & He, 2005, p. 668)	Comparatively strict prerequisites concerning the data specificity as data shall be combined for calculation.	High standardization of underlying data sets is needed in order to assure their combinability.	Underlying measurement methods have to be the same if different data sets shall be combined.

Table 3. Methodical and Theoretical Characteristics (Informed by King & He, 2005)

	Degree of formalization	Breadth of research focus	Degree of method standardization	Mathematic grounding	Theoretical background
1. Narrative review (King & He, 2005, p. 667)	Low.	Comparatively broad and subjectively chosen.	Standardized retrieval of sources, but no standard for data analysis and data presentation.	Negligible.	In general, no theoretical background necessary, but single or multiple theories possible.
2. Descriptive review (King & He, 2005, p. 667)	Low–medium.	Medium; proposition, and revelation of interpretable patterns in a population of papers are investigated.	Often standardized retrieval of sources and coding regarding arbitrary characteristics in order to be able to present quantitative results concerning a population of papers on a certain topic.	Basic arithmetic operations.	In general, no theoretical background necessary, but single or multiple theories possible.
3**. Grounded theory literature review method** (Wolfswinkel et al., 2013)	Medium.	Comparatively broad; typically, all available appropriate sources in a field of research are analyzed to build theory (p. 47).	Proposition of standardized processes for retrieving and selecting sources and their analysis; during the coding, subjective decisions are necessary.	Negligible.	Open.
4. Stylized facts	Medium.	Comparatively broad; typically all available appropriate sources in a field of research are analyzed to develop SFs.	Operationalized methods exist for different fields of research; in this paper, we propose a method for IS research; standardized processes for the retrieval of sources and their analysis; subjective decisions are included.	Basic arithmetic operations.	Open; even open to different research paradigms and usefully applicable regarding different basic assumptions concerning philosophy of science.
5. Vote counting (King & He, 2005, p. 667)	Medium–high.	Can be comparatively specific depending on the goal of the conducted research.	Typically standardized retrieval of sources, coding of data; depending on the understanding of "vote counting" also a standardized treatment of significance levels etc.	Basic and advanced arithmetic operations depending on the type of "vote counting".	In general, no theoretical background necessary, but single or multiple theories possible.
6. Meta-analysis (King and He, 2005, p. 668)	High.	Comparatively narrow research focus; data is typically combined and investigated on one specific phenomenon.	High degree of method standardization.	Basic and advanced arithmetic operations for statistical analysis.	Typically, the theoretical background of a meta-analysis is dominated by one single theory.

This comparative analysis shows that different graduations of literature review approaches have developed based on different underlying goals. While, according to the Tables 1-3, the grounded theory literature review method (Wolfswinkel et al., 2013) has several commonalities with SFs, they do have significant differences concerning not only the process of using the method. While the grounded theory literature review method aims to inductively build new theories using literature in the first place (which is also the general purpose of every grounded theory endeavor), SFs are theory independent and can serve several further purposes such as testing and comparing existing theories' explanatory power and, thus, identifying and measuring scientific progress (Heine et al., 2005, 2007). Hence, while the grounded theory

approach tries to present new theory, SFs are only cornerstones or intermediate steps on the way to new theories that are supposed to be further developed in a discourse of researchers. In Section 4, we illustrate SFs' usefulness by comparing them to other approaches against the background of specific situations in IS research and using more concrete examples.

4 On The Usefulness of Stylized Facts for IS Literature Reviews

Against the background that IS research is a relatively young field that is still in the process of establishing its theoretical and methodical core, a lot of research results exist in IS that are based on different theoretical foundations that originate from different related fields of research such as economics, psychology, sociology (Houy, Fettke, & Loos, 2011a, 2014a; Houy, Frank, Niesen, Fettke, & Loos, 2014b; Lim, Saldanha, Malladi, & Melville, 2009) and on different research methods. Hence, in order to obtain an overview of the existing scientific knowledge in IS, the problem of aggregating these methodically different findings arises. Many review studies in IS use narrative or descriptive review approaches to draw a picture of the current knowledge, which is rather easily possible because the reviewed literature does not have to fulfil specific requirements. In many cases, reviews are based on a systematic retrieval of sources (Booth et al., 2012), but the analysis and synthesis of the underlying literature's content is hardly standardized and choices made in this process often remain nontransparent. Of course, narrative or descriptive reviews can provide interesting results. But the findings from underlying sources are often merely juxtaposed and hardly aggregated or integrated in a transparent and formalized manner.

A more standardized and structured way of analyzing the findings in the underlying literature sources is provided by vote counting approaches that document observed effects (positive, negative, no effect) in different studies to investigate a predominant effect by counting the number of studies with similar effects. Vote counting approaches offer interesting insights into aggregated results and have several commonalities with the SF approach that we propose in this paper. However, the aggregated results in vote counting have to deal with exactly the same topic and, furthermore, have to deal with this topic on the same level of granularity. This is probably one of the major drawbacks of vote counting in the IS context because IS research results are not yet as standardized as the results of more mature fields like medicine or biology. Systematic methods for adapting the results' level of granularity are not provided by most vote counting approaches. This problem is even more severe for more "sophisticated" vote counting approaches that consider and calculate effect sizes, p-values, and so on.

In the SF approach, the aforementioned problem is treated by means of a transparent process of stylization, which we explain in more detail in Section 5. Indeed, the process of stylization cannot be fully standardized either because the stylization strongly depends on the particular content. However, the SF approach provides a frame for one to transparently adapt and abstract findings concerning the necessary level of granularity to make the input data more comparable. Furthermore, inter-subjectively comprehensible results shall be produced using the SF approach.

As we mention above, little research results in IS that allow for a proper usage of meta-analysis approaches exist because the provided research results are often too diverse in their presentation and their raw data are not always available. Of course, counterexamples exist, such as the research on the technology acceptance model (TAM) (Davis, 1989) or on IT adoption. Some reasons for the possibility of a meaningful usage of meta-analysis approaches in these areas are, for example, the high number of existing studies (due, in turn, to the high number of researchers researching particular topics) and the existence of established measurement instruments by which comparable research results can be produced. However, this is not the case for other topics of interest in current IS research. Against the background that the validity of meta-analyses strongly depends on the number of (appropriate) underlying studies, it will probably take some more time until an adequate number of comparable studies on further topics exist in IS research and until meta-analysis approaches can be considered a central IS research method.

Hence, based on the described drawback of IS literature review methods in the depicted situation, SFs can offer some interesting advantages. One major advantage lies in the possibility of adapting the level of granularity of the research results by means of a transparent process of stylization. Thus, SFs combine some of the advantages of more "liberal" approaches (narrative and descriptive review) with a more standardized and formalized way of analyzing studies' underlying content. However, this process has to be performed in a transparent and inter-subjectively accessible way in order to develop valid and convincing results.

Furthermore, the SF approach supports researchers in documenting every potentially interesting piece of information articulated in underlying studies. Thus, a richer spectrum of relevant information can be provided in comparison to other approaches that only focus on correlations or effect sizes. Because it is possible to consider all available studies dealing with a certain topic—independently of their research method—the overall number of underlying sources is likely to be higher compared to the mentioned "more formal" approaches (vote counting and meta-analysis). Thus, positive effects based on triangulating quantitative and qualitative results can be expected. Moreover, the SF approach can also be used when few relevant studies exist, which is a major problem of vote counting and especially of meta-analysis. Nevertheless, the resulting SFs have to be carefully judged considering the lower number of sources and the quality of underlying sources (*level of evidence*) (see Section 6 for more information).

In this section, we argue for some specific advantages of SFs in the context of IS research in comparison to other common IS literature review approaches. However, our argumentation has to be seen in the light of a certain limitation. We have built our argumentation on the typical common characteristics of the mentioned review methods. Sometimes, the effects and characteristics of a certain review method depend on the particular concrete usage and on the usage context, which can differ in detail. Nevertheless, we believe that our argumentation can illustrate some specific advantages of SFs for literature reviews in IS.

To conclude, SFs should not be considered to be generally superior to other literature review approaches but rather to be more adequate and useful in certain situations, especially against the background of the current situation regarding the general availability of well-documented empirical research results in IS research. In Section 5, we discuss the potential that SFs offer for theory development in more detail.

5 On The Potential of Theory Development with Stylized Facts

5.1 Theory and Theory Development in Information Systems

Theory development is one of the major tasks of every scientific field and so of IS research (Houy et al., 2011a; Houy et al., 2014a; Houy et al., 2014b). In this context, a systematic and reliable creation of knowledge based on scientific standards is crucial (Chalmers, 1999). However, the terms knowledge and theory have been controversial for as long as researchers have been thinking about them. That is, there is no consistent understanding of these terms. Here, we understand knowledge in a "classical" sense as a belief or opinion that is justified on the basis of acceptable justification standards and which, furthermore, satisfies the claim of being true (Fettke, Houy, & Loos, 2010a). Theory is, then, a common term for a structured representation of knowledge (Frank, 2006; Gregor, 2006; Thagard, 1988). As Houy et al. (2011a), Houy et al. (2014a), and Houy et al. (2014b) have argued, in many fields of research, especially in the natural sciences, that theories represent "systems of law-like statements", so called nomological hypotheses (if-then-statements), which primarily try to describe cause-effect relationships between constructs. Theories have different purposes such as describing, explaining, and predicting observable phenomena (Dubin, 1978). Corresponding to this understanding, well-defined constructs (Dubin's "units", X and Y) are a theory's most important components. Constructs are put into a relationship by law-like statements ("If X then Y"). Such theories try to formulate law-like statements that describe deterministic cause-effect relationships. However, in socio-scientific fields such as economics or IS, it is debatable whether such hypotheses can be regarded as causal or deterministic relationships because of the complex dependencies in the studied systems (Houy et al., 2011b). In such a context, hypotheses describe statistical correlations rather than deterministic cause-effect relationships.

Gregor (2006) has formulated a widely accepted conceptualization of the term theory in IS research that structures and extends the above understanding of theory for several special requirements and characteristics of IS research. Gregor's framework differentiates the following five types of theory:

1) Theory for analyzing, which describes theory's "lowest level", is concerned with properly defining a theory's constructs without describing relationships between them (terminology).
2) Theory for explaining, which aims to explain phenomena and provide a deeper understanding concerning how and why a relationship between two or more constructs exists.
3) Theory for predicting, which supports the prediction of what will be (not necessarily based on a deeper understanding why this happens).
4) Theory for explaining and predicting, which supports both the prediction of what will happen and the explanation of how and why it will happen.

5) Theory for design and action, which supports the design, construction, and usage of IS artefacts.

While the first type is concerned with defining and describing fundamental constructs, we can see that types 2 to 4 represent theory in a "classical" sense (Houy et al., 2011b). As we mention above, these theory types specify and explain law-like relationships between defined constructs. Type 5 describes so-called design theories that are of special interest in sciences of the artificial (H. A. Simon, 1996) and engineering fields that develop innovative artificial objects. Against the background of the growing importance of design-oriented research in IS (Hevner, March, Park, & Ram, 2004), design theories have been intensely discussed in leading IS journals in the last years (e.g., in JAIS or MISQ) (Gregor & Jones, 2007; Pries-Heje & Baskerville, 2008). According to the first contribution on design theories in the context of IS by Walls, Widmeyer, & Sawy (1992), design theories support the design and development of IS artefacts and their usage by formulating prescriptive or normative statements. Design theories play an important role in IS and were, thus, also considered in Gregor's framework. How to develop these different types of theory properly is still under discussion in literature.

Theory development in IS has to deal with restrictions similar to those in social science fields. The discussion of theory development approaches for social sciences has a tradition spanning several centuries. Meanwhile, a whole host of approaches for theory development has been presented (Freese, 1980; Merton, 1968; Weick, 1989), which has also had an impact on IS. Furthermore, Dubin's work (1978), which focuses on theories' structure, is often cited in IS theory development contributions. Based on Dubin's theory definition, Holton and Lowe (2007) propose a seven-step research procedure model. Like many other procedure models for theory development, it is based on the hypothetico-deductive method that goes back to Popper's (1959) ideas formulated in *The Logic of Scientific Discovery*. This method relies on falsifying hypotheses deduced from existing theory and is motivated by Popper's critique of inductive and positivistic research approaches. The hypothetico-deductive method has been further developed during the continuing epistemological discourse (e.g., by Lakatos (1978) and Kuhn (1996)), which has demonstrated that Popper's approach had to be further extended and refined. One important refinement of Popper's approach was, for example, as follows: successfully falsifying a hypothesis does not have to end up in totally abandoning the entire theory). Additional auxiliary hypotheses could be added to such a theory and then be falsified again. Furthermore, specific use cases could be excluded from the theory.

However, in the IS field, using this approach confronts theorists with a well-known paradox (Holton & Lowe, 2007): what can be done if so far no theory exists for explaining an interesting observable phenomenon? In this context, combinations of inductive and deductive approaches used in an iterative theory development process (building and testing) have been proposed and discussed by several contributions (Bourgeois, 1979; Carlile & Christensen, 2005; Glaser & Strauss, 1967; Handfield & Melnyk, 1998; Kerssens-van Drongelen, 2001; Merton, 1968). This is also of special value for theory development in IS research (Gregor, 2009).

Following these ideas, the starting point of an original theory can be inductively built based on observations made in the real world. These observations can serve to help researchers formulate new hypotheses and potential relationships. Hypotheses can then be tested against further empirical observations following the common hypothetico-deductive method. Moreover, the developed findings can be compared to other existing theories in order to test single statements or the whole system of statements. If indicated, single statements can be revised or tested again based on further empirical data. A system of statements can also preliminarily prove true. Figure 5 illustrates the described theory development process inspired by Lauth & Sareiter (2005).

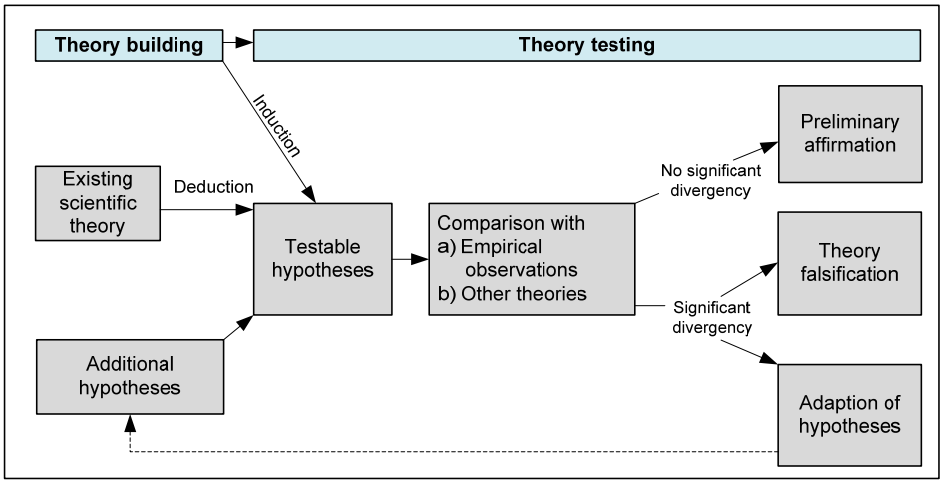

Figure 5. Theory Development (Inspired by Lauth & Sareiter, 2005; Houy et al., 2011b)

5.2 The Potential of Stylized Facts in IS Theory Development

In the process of theory development illustrated in Figure 5, SFs can offer considerable potential. SFs can contribute to original theory building and to testing and comparing theories' explanatory power (Heine et al., 2007; Helfat, 2007; Houy et al., 2011b) (see Figure 6).

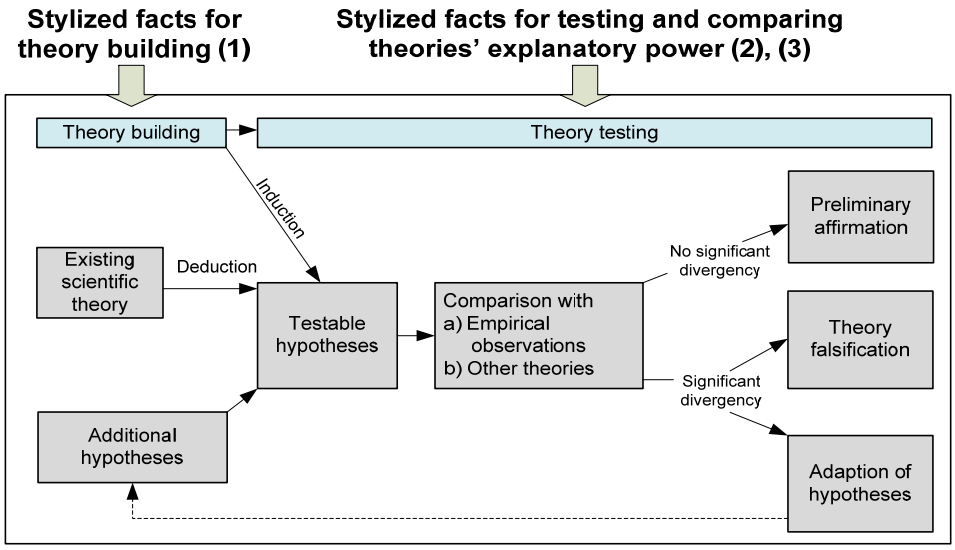

Figure 6. Theory Development by Means of Stylized Facts (Based on Figure 5)

(1) SFs as the starting point of inductive theory building: SFs can represent relationships or correlations that are widely supported by empirical data. Such relationships can serve as a valuable starting point for building new theories (Snidal, 2008) if they are interpreted as hypotheses already rich in content (induction). Following the common logic of scientific discovery, these hypotheses have to be falsified later based on further empirical data. After identifying stable relationships, discovering plausible arguments explaining why a certain relationship exists is necessary (Sutton & Staw, 1995; Whetten, 1989). However, such relationships can be regarded as promising starting points for developing new theoretical models. The process of developing SFs can significantly assist in discovering such arguments and explanations because many different sources—looking at a certain research problem from many different angles (e.g., case studies or experiments)—can give interesting detailed insights into the problem.

(2) Testing theories' explanatory power with SFs: if SFs are interpreted as widely supported empirical phenomena, they allow the testing of theories' explanatory power. SFs can be used to challenge

explanations, predictions, or design proposals of existing (design) theories in a particular domain. If SFs correspond with according statements of a theory, the theory has proven to be able to replicate an empirically observable phenomenon, else a certain "gap" in the explanatory power of the theory has become obvious. Thus, SFs can also indicate a potential necessity of adapting the theory.

(3) Comparison of theories' explanatory power: SFs can be used to compare the explanatory power of different theories in the same domain. If SFs are interpreted as broadly supported empirical phenomena, they allow one to identify the particular theory that can best explain or predict a phenomenon that is, indeed, observable in the real world.

As we mention above, SFs' potential is interesting not only in the context of theory development and theory comparison in economics, but also in other empirical and design-oriented fields. Houy et al. (2013) have argued that SFs can also make a significant contribution to theory development in IS based on the synthesis of research results by means of literature reviews. Moreover, Houy et al. (2011b) have argued that, in IS research, several theoretical models have been developed according to the above described iterative process such as the DeLone and McLean information systems success model. However, although this model was developed without referring to the SF concept, the model's authors chose a similar approach for inductive theory building (DeLone & McLean, 1992). In a first step, they based the IS success model on the central findings of 100 empirical studies (laboratory experiments, surveys, case studies, etc.) that dealt with IS success and on 80 conceptual studies in this context. They abstracted their findings from details and aggregated them (similar to SFs) to formulate the IS success model's central statements (Houy et al., 2011b). For example, the relationship between the use of information systems ("use") and an increased work performance of an organization ("organizational performance") in the IS success model has been derived from 20 methodically different empirical studies with differently operationalized performance constructs (e.g., "profit", "cost effectiveness", "IS contribution to meeting goals", "return on assets", etc.) (Houy et al., 2011b). Furthermore, DeLone and McLean used an analog approach to test and further develop the IS success model's core statements ten years later (DeLone & McLean, 2003). They investigated their model's explanatory power based on the key findings of about 100 empirical studies that used the IS success model as a theoretical foundation in different contexts in the past 10 years. The central statements of included studies were generalized and aggregated (similar to SFs) before using them in the sense of SFs for testing the theory's explanatory power. Based on the generalized and aggregated statements of the 100 empirical studies, DeLone and McLean adapted and improved the IS success model by introducing newly developed hypotheses and sorting out hypotheses that have not proven to be relevant (Houy et al., 2011b). In Section 6, we introduce an operationalized method for developing SFs in IS.

6 Operationalized Method for the Development Of Stylized Facts In IS

6.1 Preliminary Remarks

In recent years, "stylized facts" has become a widely used technical term in different fields of research. Our brief exploratory investigation of available papers using SFs (Figure 1) shows that SFs are actually widely known and used. However, looking at some exemplary papers, many researchers use this term—which is in many cases not explicitly defined—to describe complex phenomena and effects, which are undoubtedly accepted in a community, in a more easily understandable way (Clark, 1998; Gil, 2010; Lamba, 2010; Lorena, Marques, Kooijman, & Sousa, 2010; Lux & Schornstein, 2005; Ozturk, 2010; Sacks, Stevenson, & Wolfers, 2012; Treiber, Kesting, & Helbing, 2010). However, we could only identify several papers that deal with concrete methods for transparently developing SFs (e.g., the procedure models, which can be considered operationalized methods for the development of SFs, in Schwerin, 2001; Heine et al., 2007; Weißenberger & Löhr, 2007) in the context of economics and business administration. Moreover, (Houy et al., 2009) documents a first adaption of a combination of these methods and its usage in the context of IS research. However, in the already mentioned discussion panel in BISE on SFs' potential and challenges in IS research (Loos et al., 2011), Ulrich Frank critically mentioned that "it is not part of the approach to question the quality of the analyzed studies" (p. 115), which is, indeed, a weakness of known SF methods. We considered this point in our operationalized method for developing SFs and propose a taxonomy for assessing the level of evidence of statements that can be used for developing and evaluating SFs. Assessing the level of evidence helps to estimate a SF's quality. We present and explain our revised method in the next subsection.

6.2 Operationalized Method for the Development of Stylized Facts

SFs are typically developed on the basis of a structured review and analysis of sources. One significant difference between SFs and typical review methods lies in the process of abstracting the content from the details (stylization). An important goal during the process of stylization is to reach the highest possible transparency concerning how the results were generated. Thus, it is of utmost importance to ensure a high level of inter-subjective accessibility and reproducibility of results by making the development process as comprehensible and transparent as possible. Figure 7 presents the general procedure model for developing SFs based on the ideas of Heine et al. (2007) and Weißenberger and Löhr (2007).

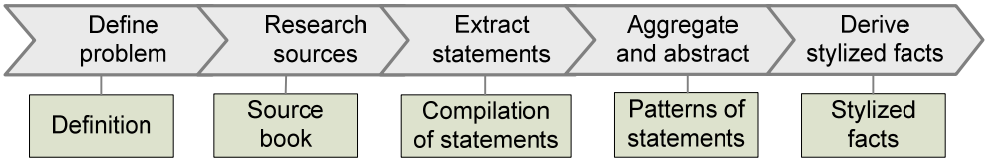

Figure 7. Procedure Model for the Development of Stylized Facts (Houy et al., 2009; Houy et al., 2011b; informed by Heine et al., 2007; Weißenberger & Löhr, 2007)

In the first phase ("Define problem"), the field of interest or phenomenon that is to be investigated with SFs has to be determined. It is certainly not a simple endeavor to identify all relevant concepts and important terms describing the field of interest or phenomenon. This is equally valid for all types of methods for literature review and research synthesis. Most current literature review contributions provide a detailed description of search terms used for the retrieval of sources. This helps to improve the reproducibility of results. However, the problem of finding and choosing all relevant terms—including all synonyms from related work that does not include these particular concepts and terms—remains. The identification of all relevant concepts and search terms is typically an iterative process.

In the second phase ("Research sources"), all available contributions are identified via systematic database usage. It is important that the results are traceable; for example, for researchers who try to replicate the results. Common strategies for soundly retrieving sources for literature reviews are described, for example, in Cooper (1998). In this context, it is, thus, highly important to rigorously document the literature search process (vom Brocke et al., 2009a).

In the third phase ("Extract statements"), statements about the investigated field of interest or phenomenon are extracted for each identified source. At first, direct quotations should be extracted from the sources in such a way that they are understandable and fitting the original context. In case of doubt, further preceding or following sentences can also be extracted in order to assure the originally intended statement's meaning. This is done for all available sources. Thus, statements regarding the investigated phenomenon are compiled. Furthermore, the direct quotations should be assessed concerning their informative value and their validity. Therefore, we use the taxonomy introduced for assessing the quality of design knowledge by Fettke et al. (2010a) and Fettke et al. (2010b). This taxonomy describes different levels of evidence which can serve as a quality assessment of each direct quotation (Fettke et al., 2010a, p. 353; Fettke et al., 2010b, p. 3):

- Level 1: plausible statement without further justification. The statement is not obviously false and neither conceptually nor empirically supported. Example: "Technique T is easy to use".
- Level 2: plausible statement that is proven by mere conceptual consideration without empirical evidence. Example: "Technique T is easy to use since, during its design, the key success factor of a clear user interface was taken into consideration".
- Level 3: statement that is backed up by exemplary experience. Example: "Technique T is easy to use. This was illustrated by three case studies in which T was exemplarily used.".
- Level 4: statement that has held good in a variety of applications. Example: "An experiment with a representative group showed that the technique T is easy to use for a significantly higher proportion of users (90%). Conflicting observations were made for some few participants."
- Level 5: statement that applies without exception or which can be deductively derived from acknowledged statements. Example: "Accepted assumption: Process modeling languages

support communication about business processes. Fact: Technique T is a process modeling language. Conclusion: T supports communications on business processes.".

The gathered information on underlying statements' level of evidence can later be aggregated to assess a SF's quality. In order to document relevant information when extracting statements, Table 4 provides an adequate structure (based on the ideas in Heine et al. (2007). Table 4 also presents some exemplary data related to the following application example on SFs regarding the business process modeling technique event-driven process chains (EPCs) in Section 7.

Table 4. Documenting and Assessing Original Statements

Nr.	Source	Source's research method and context	Original statement	Evidence level
1	van der Aalst (1999)	Design-oriented, conceptual paper on the formalization of event-driven process chains.	"Event-driven process chains are an intuitive graphical business process description language.… The language is targeted to describe processes on the level of their business logic, not necessarily on the formal specification level, and to be easy to understand and use by business people."	1
2	van der Aalst (1999)	See above.	"Although event-driven process chains have become a widespread process modeling technique, they suffer from a serious drawback: neither the syntax nor the semantics of an event-driven process chain are well defined. As a result, an event-driven process chain may be ambiguous."	2
…	…	…	…	…
42	Loos & Fettke (2001)	Design-oriented, conceptual paper on the integration of business process modeling and object-oriented software development.	"One of the main advantages of the EPC is that it is both powerful and easily understandable for end-users. EPCs are often used for capturing and discussing business processes with people who have never been trained in any kind of modeling tech-nique…. Although EPCs can be understood even by short-time trained personnel, the same models can be refined and used for the requirements definition of an information system. This is one of the reasons that both many end-user companies and many software vendors are using EPCs for business process modeling."	2
…	…	…	…	…
122	Mendling & Ziemann (2005)	Design-oriented conceptual paper on the transformation of event-driven process chains.	"EPCs are especially well suited to serve as a target for a mapping from BPEL. Firstly, the graphical notation of EPCs is standardized which facilitates understandability. Secondly, as EPCs are well understood by business analysts, because they are frequently used to represent business requirements, e.g. in the context of SAP with the SAP Reference Model (KT98)."	3
…	…	…	…	…
140	Sarshar & Loos (2005a)	Laboratory experiment on the comparison of understandability of business process models modelled with Petri nets and event-driven process chains (EPCs) with 50 students.	"The overall comprehension of the control-flow of the EPC group was significantly better than the C/E net group."	4
141	Sarshar & Loos (2005a)	See above.	"There is a tendency that the perceived ease-of-use of the EPC notation is higher than C/E net."	4

In phase 4 ("Aggregate and abstract"), patterns in the compilation of statements are first searched and similar statements are grouped. Then, a generalized statement is developed by summarizing the content that the underlying quotations have in common and by abstracting from irrelevant details.

Then, in phase 5 ("Derive stylized facts"), the SFs are developed by further abstracting the generalized statements. In several underlying contributions (e.g., Schwerin, 2001; Heine et al., 2007; Weißenberger & Löhr, 2007), the process in phases 4 and 5 is a two-stage process from quotations to (1) generalized statements to (2) SFs. However, we argue that the exact specification of this multi-stage process depends on the underlying data and the investigation's level of detail. Hence, it might be reasonable or necessary to use a three- or four-stage abstraction process in some cases to present convincing abstraction results. In other situations—especially when the amount of available studies is low or if studies do not provide a lot of heterogeneous results—it could be reasonable to develop a SF in a one-stage abstraction process directly from original quotations. In every case, it is of utmost importance to keep this derivation process inter-subjectively accessible and understandable. Table 5 demonstrates the derivation of generalized statements and one SF based on the original statements (direct quotes).

Table 5. Documentation of the Abstraction Process when Developing SFs

Nr.	Original statement	Generalized statement	Stylized fact	Nr. of sources supporting SF	Max. level of evidence (SF)
1	"Event-driven process chains are an intuitive graphical business process description language…. The language is targeted to describe processes on the level of their business logic, not necessarily on the formal specification level, and to be easy to understand and use by business people."	EPCs are an intuitive process modeling language.	EPCs are easy to understand.	12	3
42	"One of the main advantages of the EPC is that it is both powerful and easily understandable for end-users. EPCs are often used for capturing and discussing business processes with people who have never been trained in any kind of modeling technique…. Although EPCs can be understood even by short-time trained personnel, the same models can be refined and used for the require-ments definition of an information system. This is one of the reasons that both many end-user companies and many software vendors are using EPCs for business process modeling."	EPCs are easily understandable for end-users.			
		End-users only need a short training to understand EPCs.			
122	"EPCs are especially well suited to serve as a target for a mapping from BPEL. Firstly, the graphical notation of EPCs is standardized which facilitates understandability. Secondly, as EPCs are well understood by business analysts, because they are frequently used to represent business requirements, e.g. in the context of SAP with the SAP Reference Model (KT98)."	EPCs are easily understandable for business analysts.			

To assess the developed SFs' quality, we suggest counting and assigning the total number of different sources supporting the SFs and the highest level of evidence of the underlying statements. Based on this information, the total acceptance of a SF in the research community (consensus analysis) and its relevance and validity can be estimated. However, it is clear that frequently referencing an obviously false statement does not make the statement's content more evident. According to our explanations in Section 5, SFs can be used for different purposes; for example, to develop networks of broadly supported statements that can foster the emergence of new theoretical models. In this context, SFs in the form of factual statements such as "EPCs are easily understandable" or in the form of relational statements such as "The higher a person's modeling experience, the better the process model understanding performance" can be combined into a coherent network of statements (see Section 7 for more detail).

7 Exemplary Application of Stylized Facts For Theory Development

7.1 Developing Stylized Facts Concerning Event-Driven Process Chains

In this section, we describe and discuss developing and using SFs in the context of business process modeling with the modeling technique event-driven process chains (EPCs) (Keller, Nüttgens, & Scheer, 1992; Scheer, 1998) which is widely used in organizational practice (Fettke, 2009b). Furthermore, EPCs have been a strongly influential technique for developing more recent modeling notations such as the business process model and notation (BPMN). In this application example, we chose EPCs to develop SFs and use them to develop a network of statements because a lot of research on EPCs based on different research methods was conducted during the method's more than 20-year-long existence, such as laboratory experiments concerning the understandability of EPC models (Sarshar & Loos, 2005a), comparative studies regarding different modeling techniques (Kruczynski, 2008; Störrle, 2006), surveys on EPC usage in practice, or business process modeling case studies using EPCs. We also considered conceptual and design-oriented contributions to document broadly supported consensual statements concerning EPCs to demonstrate SFs' usefulness in conceptual and design-oriented research contexts. In this example, we focus on building a model that describes observable phenomena and relationships concerning EPCs that constitute a consensus of researchers involved in business process modeling and EPC research[3].

1. Define problem

Using process modeling techniques is a widespread phenomenon in current organizations and enterprises and is, thus, a relevant topic for IS research. To better understand, explain, and predict occurring phenomena concerning the usage of process modeling techniques and to support the (further) development of useful process modeling techniques, the documented knowledge has to be investigated to develop SFs regarding EPCs.

2. Research sources

The underlying EPC knowledge used to develop SFs in this research stems from scientific contributions published in books, conference proceedings, journals, or research reports. To identify available papers on EPCs, we systematically retrieved a sample of EPC contributions from 1999 to 2009. In 2009, the last EPC conference took place in Berlin. We chose this period of time in order to have a comprehensive but also manageable amount of literature for this exemplary application of SFs. We searched for "EPC" and "event-driven process chains" and the identical German expressions "EPK" and "Ereignisgesteuerte Prozesskette" in EBSCOhost (international literature database) and WisoNet (German literature database) because a lot of EPC contributions have been published in German. Furthermore, we added papers published in the proceedings of the EPC conference in the mentioned time span that were not captured by our systematic retrieval in the databases. In total, we identified 86 relevant papers on EPCs, which we then then analyzed using the above-described SF method.

3. Extract statements

We iteratively analyzed all 86 papers and extracted and documented relevant statements concerning the EPC modeling technique (e. g. see Table 4). While extracting the single statements, candidates for potential "generalized statements" and SFs were identified. Against the background of emerging central concepts treated in EPC literature, we repeated this analysis several times to identify as many relevant statements as possible.

[3] An early state application example of SFs in the context of EPC research was published in the proceedings of the EPC conference 2009 in German (Houy et al., 2009). Houy et al. (2011b) further develop and report on the results and demonstrate our experience with SFs in design-oriented IS research. These contributions also initiated the discussion presented in Loos et al. (2011). These works were mostly communicated in the German-speaking IS (*Wirtschaftsinformatik*) community. However, in more recently published papers, we have presented the potential and our experiences with SFs to the international IS community (e.g., at HICSS 2013 (Reiter, Fettke, & Loos, 2013) or at the pre-ECIS workshop "Building up or Piling Up? The Literature Review in Information Systems Research" (Houy et al., 2013)).

4. Aggregate and abstract

We present a brief example of this phase in Table 5. Based on this table, the process of grouping and abstraction can be comprehended in detail and is, thus, transparent.

5. Derive stylized facts

Table 5 also shows an exemplary derivation of a SF concerning the understandability of EPC models. This example once again illustrates the abstraction from details in the second stage of the process. It transparently demonstrates how a SF was developed and how this SF can be justified.

Henceforth, we do not present and discuss all available SFs concerning the EPC that we developed in the course of this exemplary application. Rather, we concentrate on demonstrating SFs' general potential for IS research[4]. Therefore, we present a selection of the most important SFs concerning the EPC with at least three different supporting sources. Table 6 illustrates the SFs, the number of sources supporting them, the highest level of evidence of underlying sources to estimate the validity of the SFs, and the references supporting the SFs.

Table 6. Selection of Stylized Facts on Event-driven Process Chains (EPC)

Stylized fact	Number of supporting references / max. level of evidence	References
1. EPC are a widely used modeling language.	40 sources / level 4	(Brüning & Forbrig, 2008; Dehnert, 2001, 2002; Dünnebacke & Rhensius, 2009; Fettke, 2009a; Fettke & Loos, 2003; Gadatsch, 2009; Green & Rosemann, 1999, 2000; Gruhn & Laue, 2006, 2007; Kahl & Kupsch, 2005; Kruczynski, 2008; Loos & Fettke, 2001; Lübke, Marx Gómez, & Schneider, 2005; Mendling, Brabenetz, & Neumann, 2004; Mendling & Nüttgens, 2003a, 2003b, 2003c, 2003d; Mendling, van Dongen, & van der Aalst, 2007; Mendling, Verbeek, van Dongen, van der Aalst, & Neumann, 2008; Moldt & Rodenhagen, 2000; Nüttgens & Rump, 2002; Recker, Rosemann, Indulska, & Green, 2009; Rittgen, 2000b, 2000c; Rodenhagen, 2002; Sarshar & Loos, 2005b; Scheer & Thomas, 2005; Schneider & Schreiner, 2003; C. Simon, Freiheit, & Olbrich, 2006; Thomas, Hüsselmann, & Adam, 2002; Thomas, Kaffai, & Loos, 2005; Thomas, Seel, Seel, Kaffai, & Martin, 2004; van der Aalst, 1999; van Dongen & Jansen-Vullers, 2005; van Hee, Oanea, & Sidorova, 2005; vom Brocke, Sonnenberg, & Simons, 2009b; Wehler, 2007)
2. EPC models can be ambiguous.	17 sources / level 3	(Cuntz, Freiheit, & Kindler, 2005; Cuntz & Kindler, 2004; Dehnert, 2001; Dehnert & Rittgen, 2001; Fettke & Loos, 2003; Fichtenbauer, Rumpfhuber, & Stary, 2002; Mendling & Nüttgens, 2003a; Mendling & van der Aalst, 2006; Recker et al., 2009; Rittgen, 2000a, 2000b, 2000c; Rodenhagen, 2002; Thomas & Fellmann, 2006; van der Aalst, 1999; van der Aalst, Desel, & Kindler, 2002; Wehler, 2007)
3. The EPC method is easy to understand.	12 sources / level 3	(Becker, Algermissen, & Niehaves, 2003; Dehnert, 2001, 2002; Green & Rosemann, 2000; Kruczynski, 2008; Krumnow, Decker, & Weske, 2008; List & Korherr, 2006; Loos & Fettke, 2001; Mendling & Ziemann, 2005; Rittgen, 2000c; Thomas et al., 2004; van der Aalst, 1999)
4. EPC support the communication between stake-holders.	11 sources / level 3	(Dehnert, 2002; Dehnert & Rittgen, 2001; Fichtenbauer et al., 2002; Gruhn & Laue, 2005; Krumnow et al., 2008; Loos & Fettke, 2001; Mendling et al., 2007; Recker et al., 2009; Rittgen, 2000b; Thomas & Dollmann, 2006; van Dongen, Jansen-Vullers, Verbeek, & van der Aalst, 2007)
5. EPC enable intuitive graphical process models.	11 sources / level 2	(Becker et al., 2003; Dehnert, 2001, 2002; Kopp, Unger, & Leymann, 2006; Kruczynski, 2008; Mendling & Nüttgens, 2003a; Mendling et al., 2007; van der Aalst, 1999; van Dongen & Jansen-Vullers, 2005; van Dongen et al., 2007; Wehler, 2007)
6. EPC represent an established standard method for process modeling.	10 sources / level 2	(Kahl & Kupsch, 2005; Kruczynski, 2008; Krumnow et al., 2008; Petsch, Schorcht, Nissen, & Himmelreich, 2008; Schneider & Schreiner, 2003; Seel & Vanderhaeghen, 2005; Seidlmeier & Scherfler, 2007; Thomas & Dollmann, 2006; Thomas et al., 2005; Thomas et al., 2004)
7. The semi-formal semantics of EPC allows for developing expressive models with a high degree of freedom.	5 sources / level 2	(Dehnert, 2002; Fettke & Loos, 2003; Rittgen, 2000b; Scheer & Thomas, 2005; Wehler, 2007)

[4] For a more detailed overview of design-related knowledge on EPCs, please see Fettke et al. (2010b).

Table 6. Selection of Stylized Facts on Event-driven Process Chains (EPC)

8. The EPC method is easy to learn.	5 sources / level 2	(Dehnert, 2001, 2002; Dehnert & Rittgen, 2001; Loos & Fettke, 2001; Rittgen, 2000c)
9. EPC models can be misunderstood.	4 sources / level 3	(Dehnert, 2001; Dehnert & Rittgen, 2001; Rittgen, 2000b; Schmidt, Fleischmann, & Gilbert, 2009)
10. Numerous users and consultants are familiar with the EPC method.	3 sources / level 3	(Mendling & Ziemann, 2005; Moldt & Rodenhagen, 2000; Rittgen, 2000a)

7.2 Discussion of Challenges in this Example and Guidance for Researchers

Although the structure of the described process of developing SFs is clear and not very complicated, it has to be mentioned that we have taken several decisions when using this approach. Besides the well-known problems of every literature review approach regarding defining and delineating the investigated problem (Which particular search terms represent the topic which I would like to investigate? Are there further synonyms? Are all relevant subareas of the topic included in my search?), we faced several specific challenges when using the SF approach in this scenario.

As for extracting statements, we had to face the problem of deciding which statements were relevant for the research problem. This is typically a subjective decision, which can definitely be considered a potential threat for the results' objectivity. In this exemplary scenario, we decided to extract all statements on the modeling technique EPC that we could find in the underlying papers. So, we wanted to completely document and assess all statements made about the modeling technique EPC in the underlying papers. By following this approach, no particular subjective decision had to be made in this phase of the procedure. Based on that, we iteratively identified different relevant topics in the discourse on EPC. We should note here that developing SFs is generally a time-consuming endeavor.

During the next phases—aggregating and abstracting statements and deriving SFs—we did have to make several subjective decisions. In this context, the highest possible transparency of the decision taken helps to make the results inter-subjectively accessible. The structure of the Tables 4 and 5 support users of the SF approach in transparently documenting their results and making them accessible. We recommend starting off by aggregating those statements that fit together on first sight and continue with the remaining extracted statements thereafter. Considering this order helps users of the SF approach to identify the "most consensual" patterns at first. This is important because earlier results lead the whole investigation into a certain direction. Also in this process, the highest possible transparency is of utmost importance to develop reasonable and valuable results.

In our application example, we found several contradictory statements and even developed potentially contradicting SFs, such as SF 2 ("EPC models can be ambiguous") and SF 3 ("The EPC method is easy to understand"). From our point of view, this should not be considered a problem of the approach but more an opportunity to identify conflicting opinions and belief in the investigated discourse, which can be fruitful for further scientific discussion. In the context of theory development, such conflicting evidence can also support the improvement of existing models via supplementary hypotheses, and new models with new explanations for certain phenomena can even be developed. When trying to "negotiate" between potentially contradictory statements, the documented information on the number of supporting sources (consensus analysis) and the information on the level of evidence can help the user of the SF approach to estimate which of the given contradictory statement has a stronger support in the current discourse and is "more likely to be true".

7.3 Developing a Network of Statements based on the Stylized Facts

The SFs such as those in Table 6 can then be used to develop a coherent network of statements to form a (potentially theoretical) model. Therefore, we brought together and integrated the identified SFs as a kind of causal loop diagram. Note that we do not consider the illustrated relationships as being causal but more as the communities' "consensus" about observable correlations or reasonable relationships.

In Figure 8, which illustrates the developed model a plus (+) sign indicates a supportive effect of one SF on another SF; a minus (-) sign correspondingly indicates an inhibitory effect. Note that we do not claim that the picture is exhaustive regarding all possible correlations. In contrast, we present only the most important and frequently mentioned facts, relationships, and correlations.

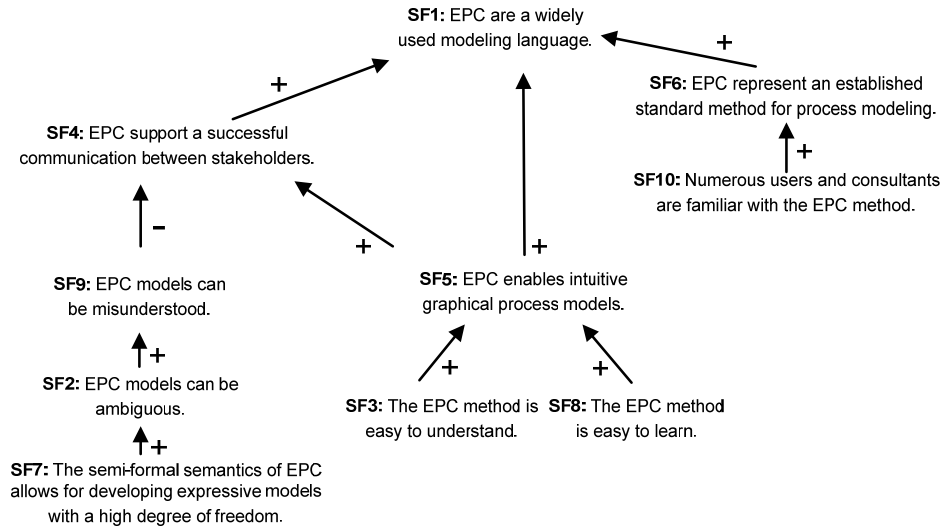

Figure 8. Conjectured Relationships Concerning EPC Usage based on SFs

In a nutshell, this model represents the conjectured relationship of the characteristic of EPC—being easily understandable and supporting successful communication between stakeholders on the one side and being widely used on the other side. Furthermore, the high degree of modeling freedom can lead to ambiguous EPC models, which can hinder successful communication. The illustrated relationships and correlations are based on broadly supported SFs, and the model can be considered a starting point for further deductive testing to develop a theoretical model following the theory development standards in IS research. In this scenario, the developed SFs have served for initial theory building.

Moreover, the developed model and the included SFs are—at least to a certain extent—in line with a well-known theoretical model in IS research, the technology acceptance model (TAM) (Davis, 1989). The TAM expresses the largely supported relationship between perceived ease-of-use and perceived usefulness on the one side and the acceptance and usage of a technological object on the other side (expressed in light grey in Figure 9). One can state that the above model and the contained empirically broadly supported statements and relationships can, to a certain extent, explain and "instantiate" the TAM in the context of business process modeling techniques. Hence, the developed SFs can, to a large extent, deliver support for the hypotheses formulated by the TAM, which serves for testing the TAM's explanatory power in the context of business process modeling techniques and especially in the context of EPCs. Figure 9 illustrates this thought and maps the relevant constructs onto each other.

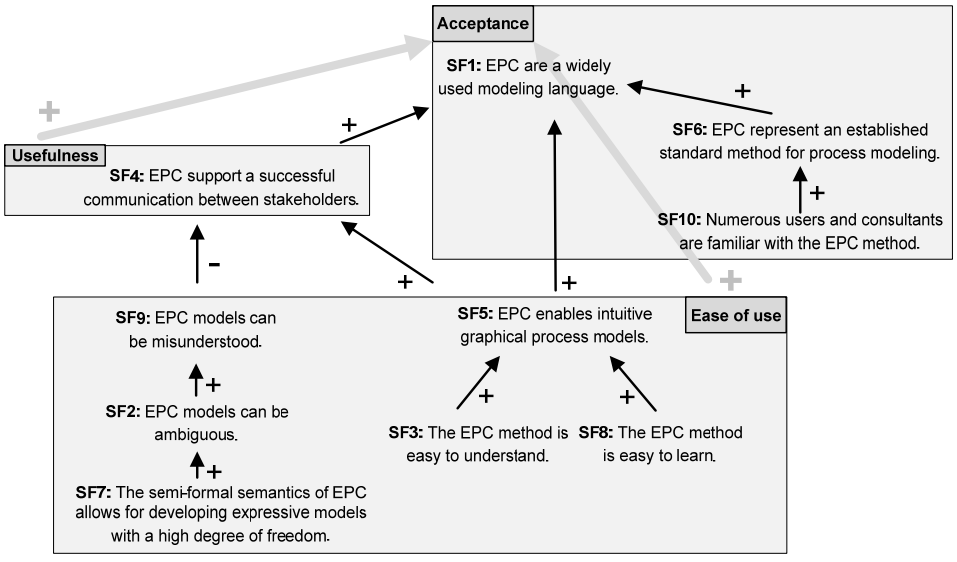

Figure 9. SFs on EPCs and the Technology Acceptance Model (TAM)

To critically assess the developed mapping in Figure 9, note that there clearly exists a difference between actual ease of use and actual usefulness as conjectured in the above model and perceived ease of use and perceived usefulness as conjectured by the TAM. However, it remains open for further discussion how this relationship can be assessed in more detail. Nevertheless, developing SFs and building networks of empirically broadly supported statements can support the development of interesting models with the potential to further develop into theories.

We admit that this exemplary usage of generated SFs for developing a coherent network of statements worked particularly well. Such "well-fitting" SFs will not be developed in every case when using the SF approach. In our experience, there will always be an amount of SFs in other "real-world scenarios" that treat completely different topics and that cannot be reasonably integrated into a coherent network of statements. In Section 8, we discuss the potential and challenges of SFs for literature reviews in IS more generally.

8 Discussion

SFs have the potential to initiate and support the process of developing theories in IS research. The above application example with EPCs, in which we used the presented operationalized method for developing SFs, has illustrated this potential and also several challenges when using our SF approach for literature reviews in IS. SFs are not supposed to be the final result. In contrast, they represent a useful intermediate step on the way of further developing the theoretical foundations of IS research by means of literature reviews. They are not given by nature and do not appear out of nowhere, but they are artefacts of IS research because they are constructed and further developed and discussed by IS researchers in a discourse (Fettke, Houy, Vella, & Loos, 2012). Thus, they can serve as an interesting starting point for developing theory.

SFs can furthermore help researchers to develop state-of-the-art knowledge in a field of research and to identify and define interesting phenomena of a research field that are clearly observable in reality but that still lack a clear theoretical model (Houy et al., 2013; Loos et al., 2011) such as the already mentioned productivity paradox of information technology (Brynjolfsson, 1993) or the bullwhip effect in supply chain management (SCM) (Lee et al., 1997). In this context, SFs can provide an access point to such phenomena and, moreover, motivate further research toward their clarification.

However, besides being a quite time-consuming review approach, one further problem of SFs that most of the underlying sources mention is the potential subjectivity of the abstraction process (Heine et al., 2005, 2007; Houy et al., 2013). To reduce results' subjectivity, the process of developing SFs has to be as transparent as possible. Thus, the intermediate results of the development process have to be available to support inter-subjective accessibility.

To support a faster assessment of the consensus on a SF and its validity, we suggest documenting information on the number of supporting sources for the consensus analysis and on the according level of evidence for first validity checks. It has to be further investigated how practicable and useful these ideas are when using our method for SFs in larger research projects.

Another important challenge in the context of using SFs as a literature review approach is a reasonable availability of adequate underlying data for SF studies. Armin Heinzl has already mentioned this problem in the panel discussion in Loos et al. (2011). Although empirical research approaches play an important role in IS research, interesting empirical data is not always fully accessible in IS publications. Therefore, we need to improve the full publication of data sets assessed in empirical IS research endeavors. Other research fields (e.g. medicine) already have comprehensive online infrastructures supporting a high accessibility of empirical data. IS research still needs further resources in this context that would make using the SF approach even more attractive.

Against the background of our experience with using SFs, note that there are certain fields of interest in IS research that would provide a lot of interesting "raw material" for developing SFs while other fields would not have enough results available to significantly profit from the usage of the introduced approach. However, we believe that this is a problem of every research synthesis method. In our application example, we investigated literature concerning a clearly defined area of research that has already existed for many years and for which, in consequence, an adequate amount of papers exist. However, further experience with applying SFs, especially concerning their usefulness in relation to the availability of underlying sources, is needed.

We can draw interesting implications from SFs' theory neutrality. As we state above, SFs represent observable phenomena that are independent of particular theories, perspectives, or paradigms. There has been a lot of discussion about the question whether scientific phenomena can be discussed at all if researchers look at them and rely on different paradigms (inter-paradigm discussion). At this point, SFs can offer significant potential because they are not related to particular theories and their perspectives on a phenomenon. In contrast, they are based on observations in reality and described with simple words. Thus, they do not rely on the language constructs of a specific theory or paradigm with all related background assumptions. While more research into this topic is needed, it seems yet possible to use SFs for inter-paradigm discussions concerning observable phenomena. Hence, SFs could also be investigated from the points of view of different theories or paradigms and, thus, support a multi-perspective understanding of observable phenomena in IS. Thus, interesting comparisons of the explanatory power of different theories are possible when trying to explain or predict certain SFs, which was one of their main purposes when Kaldor introduced them in the 1960s.

Every kind of literature review, however, bears the following risk, which is also valid for the SF approach: conducting a literature review does not guarantee the generation of interesting and disruptive knowledge. While this is equally valid for every kind of research, there is a particularly high risk for literature reviews and, thus, for the SF approach because already known data material is taken as a basis. Nevertheless, reviewing the past can significantly support future action by means of new insights into existing data material (Webster & Watson, 2002), and, thus, literature reviews can provide an important contribution for developing IS as a research field. Table 7 summarizes and overviews SFs' major opportunities and challenges identified in this research, which we discuss in the remainder of this paper.

Table 7. Overview of Major Potential and Challenges of Stylized Facts for IS Research

SFs' opportunities	SFs' challenges
1. Support for literature-based theory development in IS research	1. Availability of adequate empirical data
2. Transparent development of empirically supported patterns	2. Detailed treatment of conflicting evidence
3. Combination of advantages of other common review approaches	3. Speeding up the development of SFs
4. Identification of "the best theory" (explanation and prediction of SFs)	4. Securing inter-subjective accessibility of results

9 Conclusion

In this paper, we investigate, present, and discuss SFs' potential for conducting literature reviews in IS in detail. At first, we introduce the SF concept, compare SFs to other approaches for literature reviews in IS from a theoretical perspective, and discuss SFs' potential advantages in comparison with these other review approaches concerning more concrete examples in IS research. As such, we contribute to answering RQ1 and RQ2. Furthermore, in Section 5, we discuss SFs' potential for theory building, development, and comparison in more detail before presenting an operationalized method for developing and using SFs in literature reviews. Hence, Section 5 particularly addresses RQ3. In addition, we have used this method to develop SFs concerning the business process modeling technique event-driven process chains (EPCs) in an application example to illustrate its potential and also the concrete challenges for IS. Furthermore, we discuss the identified opportunities, challenges, and potential problems concerning this application example in more detail (again concerning RQ 2) and concrete workarounds. Moreover, we present guidance for researchers planning to use the proposed SF approach. Following this, we more generally discuss SFs after applying an example and summarizing the major potential and challenges of using SFs in IS research.

To conclude, we identify considerable potential and interesting research possibilities when using SFs, especially for IS theory development. Nevertheless, SFs should not be considered to be generally superior to other literature review approaches but to be more adequate and useful in certain situations (considering the current situation regarding the availability of empirical results in IS research).

In the future, we plan to further use and improve our operationalized method for developing SFs to further contribute to the development of the field's theoretical foundations. Research syntheses using SFs can—from our point of view—considerably support this important goal.

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References

Alavi, M., & Joachimsthaler, E. A. (1992). Revisiting DSS implementation research: A meta-analysis of the literature and suggestions for researchers. MIS Quarterly, 16(1), 95-116.

Becker, J., Algermissen, L., & Niehaves, B. (2003). Prozessmodellierung in eGovernment-Projekten mit der eEPK. Paper presented at the EPK 2003—Geschäftsprozessmanagement mit Ereignis-gesteuerten Prozessketten, Proceedings des GI-Workshops und Arbeitskreistreffens, Bamberg, Germany.

Benbasat, I., & Lim, L. H. (1993). The effects of group, task, context and technology variables on the usefulness of group support systems: A meta-analysis of experimental studies. Small Group Research, 24(4), 430-462.

Booth, A., Papaioannou, D., & Sutton, A. (2012). Systematic approaches to a successful literature review. London: Sage.

Bourgeois, L. J. (1979). Toward a method of middle-range theorizing. Academy of Management Review, 4(3), 443-447.

Brüning, J., & Forbrig, P. (2008). Zur Automatischen Ermittlung von Testszenarien aus EPK-Schemata. Paper presented at the Workshops colocated with the MobIS2008 Conference: Including EPK2008, KobAS2008 and ModKollGP2008, Saarbrücken, Germany.

Brynjolfsson, E. (1993). The productivity paradox of information technology. Communications of the ACM, 36(12), 67-77.

Carlile, P. R., & Christensen, C. M. (2005). The cycles of theory building in management research. Havard Business School Working Paper (Nr.05-057).

Chalmers, A. F. (1999). What is this thing called science? St. Lucia: University of Queensland Press.

Clark, G. L. (1998). Stylized facts and close dialogue: Methodology in economic geography. Annals of the Association of American Geographers, 88(1), 73-87.

Cooper, H. (1998). Synthesizing research - A guide for literature reviews (3. ed.). Thousand Oaks: Sage.

Cooper, H., & Hedges, L. V. (1994). Research synthesis as a scientific enterprise. In H. Cooper & L. V. Hedges (Eds.), The Handbook of Research Synthesis (pp. 3-14). New York, NJ: Russell Sage Foundation.

Cuntz, N., Freiheit, J., & Kindler, E. (2005). On the semantics of EPCs: Faster calculation for EPCs with small state spaces. Paper presented at the EPK 2005—Geschäftsprozessmanagement mit Ereignisgesteuerten Prozessketten, Proceedings des GI-Workshops und Arbeitskreistreffens, Hamburg, Germany.

Cuntz, N., & Kindler, E. (2004). On the semantics of EPCs: Efficient calculation and simulation. Paper presented at the EPK 2004—Geschäftsprozessmanagement mit Ereignisgesteuerten Prozess-ketten. Proceedings des GI-Workshops und Arbeitskreistreffens, Luxembourg, Luxembourg.

Davis, F. D. (1989). Perceived usefullness, perceived ease of use and user acceptance of information technology. MIS Quarterly, 13(3), 319-340.

Dehnert, J. (2001). Four systematic steps towards sound business process models. Paper presented at the 2nd International Colloquium on Petri Net Technologies for Modelling Communication Based Systems, Berlin, Germany.

Dehnert, J. (2002). Making EPCs fit for workflow management. Paper presented at the EPK 2002—Geschäftsprozessmanagement mit Ereignisgesteuerten Prozessketten, Proceedings des GI-Workshops und Arbeitskreistreffens, Trier, Germany.

Dehnert, J., & Rittgen, P. (2001). Relaxed soundness of business processes. Paper presented at the 13th Conference on Advanced Information Systems Engineering (CAISE'01), Interlaken, Switzerland.

DeLone, W. H., & McLean, E. R. (1992). Information systems success: The quest for the dependent variable. Information Systems Research, 3(1), 60-95.

DeLone, W. H., & McLean, E. R. (2003). The DeLone and McLean model of information systems success: A ten-year update. Journal of Management Information Systems, 19(4), 9-30.

Denzin, N. K. (1989). The research act: A theoretical introduction to sociological methods. Englewood Cliffs: Prentice Hall.

Dubin, R. (1978). Theory building. London: Free Press.

Dünnebacke, D., & Rhensius, T. (2009). Unternehmensindividuelle Auswahl von Prozessmodellierungstools. ERP Management, 2, 47-51.

Fettke, P. (2009a). Ansätze der Informationsmodellierung und ihre betriebswirtschaftliche Bedeutung: Eine Untersuchung der Modellierungspraxis in Deutschland. zfbf - Schmalenbachs Zeitschrift für betriebswirtschaftliche Forschung, 61(8), 550-580.

Fettke, P. (2009b). How conceptual modeling Is used. Communication of the Association for Information Systems, 22(15), 1-26.

Fettke, P., Houy, C., & Loos, P. (2010a). On the relevance of design knowledge for design-oriented business and information systems engineering. Business and Information Systems Engineering, 2(6), 347-358.

Fettke, P., Houy, C., & Loos, P. (2010b). On the relevance of design knowledge for design-oriented business and information systems engineering - Supplemental considerations and further application examples. In P. Loos (Ed.), Publications of the Institute for Information Systems (IWi) at the German Research Center for Artificial Intelligence (DFKI)—IWi-Heft, Nr. 191. Saarbrücken.

Fettke, P., Houy, C., Vella, A. L., & Loos, P. (2012). Towards the reconstruction and evaluation of conceptual model quality discourses - Methodical framework and application in the context of model understandability. In I. Bider, T. Halpin, J. Krogstie, S. Nurcan, E. Proper, R. Schmidt, P. Soffer & S. Wrycza (Eds.), BPMDS 2012 and EMMSAD 2012, LNBIP 113 (pp. 406-421). Berlin: Springer.

Fettke, P., & Loos, P. (2003). Ontologische Evaluierung von Ereignisgesteuerten Prozessketten. Paper presented at the EPK 2003—Geschäftsprozessmanagement mit Ereignisgesteuerten Prozessketten, Proceedings des GI-Workshops und Arbeitskreistreffens, Bamberg, Germany.

Fichtenbauer, C., Rumpfhuber, M., & Stary, C. (2002). Sprachgerechte unternehmensnahe Modellierung von Ereignisgesteuerten Prozessketten — Zur ädaquaten Aus- und Weiterbildung von Modellierer-Innen. Paper presented at the EPK 2002—Geschäftsprozessmanagement mit Ereignisgesteuerten Prozessketten, Proceedings des GI-Workshops und Arbeitskreistreffens, Trier, Germany.

Frank, U. (2006). Towards a pluralistic conception of research methods in information systems research (ICB-research report nr. 7). Essen: Institut für Informatik und Wirtschaftsinformatik (ICB) der Universität Duisburg-Essen.

Freese, L. (1980). Formal theorizing. Annual Review of Sociology, 6, 187-212.

Gadatsch, A. (2009). Integriertes Geschäftsprozess- und Workflow-Management – Konzeption, Rollen und organisatorische Einbindung. HMD—Praxis der Wirtschaftsinformatik, 266, 35-42.

Gil, P. M. (2010). Stylised facts and other empirical evidence on firm dynamics, business cycle and growth. Research in Economics, 64(1), 73-80.

Glaser, B., & Strauss, A. (1967). The discovery of grounded theory: Strategies of qualitative research. London: Wiedenfeld and Nicholson.

Green, P., & Rosemann, M. (1999). An ontological analysis of integrated process modelling. Paper presented at the 11th International Conference on Advanced Information Systems Engineering (CAISE), Heidelberg, Germany.

Green, P., & Rosemann, M. (2000). Integrated process modelling: An ontological evaluation. Information Systems, 25(2), 73-87.

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. Paper presented at the 4th International Conference on Design Science Research in Information Systems and Technology (DESRIST'09), Philadelphia, Pennsylvania, USA.

Gregor, S., & Jones, D. (2007). The anatomy of a design theory. Journal of the Association for Information Systems, 8(5), 312-335.

Gruhn, V., & Laue, R. (2005). Einfache EPK-Semantik durch praxistaugliche Stilregeln. Paper presented at the EPK 2005—Geschäftsprozessmanagement mit Ereignisgesteuerten Prozessketten, Proceedings des GI-Workshops und Arbeitskreistreffens, Hamburg, Germany.

Gruhn, V., & Laue, R. (2006). Validierung syntaktischer und anderer EPK-Eigenschaften mit PROLOG. Paper presented at the EPK 2006—Geschäftsprozessmanagement mit Ereignisgesteuerten Prozessketten, Proceedings des GI-Workshops und Arbeitskreistreffens, Wien, Austria.

Gruhn, V., & Laue, R. (2007). Forderungen an hierarchische EPK-Schemata. Paper presented at the EPK 2007—Geschäftsprozessmanagement mit Ereignisgesteuerten Prozessketten, Proceedings des GI-Workshops und Arbeitskreistreffens, St. Augustin, Germany.

Guzzo, R. A., Jackson, S. E., & Katzell, R. A. (1987). Meta-analysis analysis. Research in Organizational Behaviour, 9, 407-442.

Handfield, R. B., & Melnyk, S. A. (1998). The scientific theory-building process: a primer using the case of TQM. Journal of Operations Management, 16(4), 321-339.

Heine, B.-O., Meyer, M., & Strangfeld, O. (2005). Stylised facts and the contribution of simulation to the economic analysis of budgeting. Journal of Artificial Societies and Social Simulation, 8(4), 34.

Heine, B.-O., Meyer, M., & Strangfeld, O. (2007). The concept of stylized facts for the measurement and evaluation of scientific progress (in German). Die Betriebswirtschaft (DBW), 67(5), 583-601.

Helfat, C. E. (2007). Stylized facts, empirical research and theory development in management. Strategic Organization, 5(2), 185-192.

Hevner, A. R., March, S. T., Park, J., & Ram, S. (2004). Design science in information systems research. MIS Quarterly, 28(1), 75-105.

Holton, E. F., & Lowe, J. S. (2007). Toward a general research process for using Dubin's theory building model. Human Resource Development Review, 6(3), 297-320.

Houy, C., Fettke, P., & Loos, P. (2009). Stylized facts on event-driven process chains - Application of a method for theory building in information systems (in German). Paper presented at the EPK 2009—Geschäftsprozessmanagement mit Ereignisgesteuerten Prozessketten, Proceedings des GI-Workshops und Arbeitskreistreffens, Berlin, Germany.

Houy, C., Fettke, P., & Loos, P. (2011a). On theoretical foundations of empirical business process management research. In F. Daniel, K. Barkaoui & S. Dustdar (Eds.), BPM 2011 Workshops, LNBIP 99 (pp. 320-332). Berlin: Springer.

Houy, C., Fettke, P., & Loos, P. (2011b). Stylized facts in design-oriented information systems research - General potential and first experiences (in German). Paper presented at the 10th International Conference on Wirtschaftsinformatik, Zürich, Switzerland.

Houy, C., Fettke, P., & Loos, P. (2013). The concept of stylized facts as an instrument for cumulative IS research. Paper presented at the Pre-ECIS-Workshop "Building up or Piling Up? The Literature Review in Information Systems Research", Utrecht, Netherlands.

Houy, C., Fettke, P., & Loos, P. (2014a). On the theoretical foundations of research into the understandability of business process models. Paper presented at the European Conference on Information Systems (ECIS), Tel Aviv, Israel.

Houy, C., Frank, J., Niesen, T., Fettke, P., & Loos, P. (2014b). On the usage of theories in the field of Wirtschaftsinformatik - A quantitative literature analysis. Publications of the Institute for Information Systems (IWi) at the German Research Center for Artificial Intelligence (DFKI)—IWi-Heft Nr. 198. Saarbrücken, Germany.

Kahl, T., & Kupsch, F. (2005). Transformation und Mapping von Prozessmodellen in verteilten Umgebungen mit der EPK. Paper presented at the EPK 2005—Geschäftsprozessmanagement mit Ereignisgesteuerten Prozessketten, Proceedings des GI-Workshops und Arbeitskreistreffens, Hamburg, Germany.

Kaldor, N. (1961). Capital accumulation and economic growth. Paper presented at the The Theory of Capital, Proceedings of a Conference Held by the International Economic Association, London, UK.

Keller, G., Nüttgens, M., & Scheer, A.-W. (1992). Semantische Prozeßmodellierung auf der Grundlage "Ereignisgesteuerter Prozeßketten (EPK)", Publications of the Institute for Information Systems (IWi) at the German Research Center for Artificial Intelligence (DFKI)—IWi-Heft Nr. 89. Saarbrücken, Germany.

Kerssens-van Drongelen, I. (2001). The iterative theory-building process: Rationale, principles and evaluation. Management Decision, 39(7), 503-512.

King, W. R., & He, J. (2005). Understanding the role and methods of meta-analysis in IS research. Communications of the Association for Information Systems, 16(1), 665-686.

King, W. R., & He, J. (2006). A meta-analysis of the technology acceptance model. Information & Management, 43, 740-755.

Kohli, R., & Devaraj, S. (2003). Measuring information technology payoff: A meta-analysis of structural variables in firm-level empirical research. Information Systems Research, 14(2), 127-145.

Kopp, O., Unger, T., & Leymann, F. (2006). Nautilus event-driven process chains: Syntax, semantics, and their mapping to BPEL. Paper presented at the EPK 2006—Geschäftsprozessmanagement mit Ereignisgesteuerten Prozessketten, Proceedings des GI-Workshops und Arbeitskreistreffens, Wien, Austria.

Kruczynski, K. (2008). Prozessmodellierung im Wettbewerb: EPK vs. BPMN. is report, 6, 30-35.

Krumnow, S., Decker, G., & Weske, M. (2008). Modellierung von EPKs im Web mit Oryx. Paper presented at the Workshops colocated with the MobIS2008 Conference: Including EPK2008, KobAS2008 and ModKollGP2008, Saarbrücken, Germany.

Kuhn, T. S. (1996). The structure of scientific revolutions. Chicago: University of Chicago Press.

Lakatos, I. (1978). The methodology of scientific research programmes (Vol. 1). Cambridge: Cambridge University Press.

Lamba, H. (2010). A queueing theory description of fat-tailed price returns in imperfect financial markets. The European Physical Journal B, 77(2), 297-304.

Lauth, B., & Sareiter, J. (2005). Wissenschaftliche Erkenntnis. Eine ideengeschichtliche Einführung in die Wissenschaftstheorie. Paderborn: mentis.

Lee, H. L., Padmanabhan, V., & Whang, S. (1997). The bullwhip effect in supply chains. Sloan Management Review, 93-102.

Lim, S. H., Saldanha, T., Malladi, S., & Melville, N. P. (2009). Theories used in information systems research: Identifying theory networks in leading IS journals. Paper presented at the International Conference on Information Systems (ICIS), Phoenix, Arizona, USA.

List, B., & Korherr, B. (2006). An evaluation of conceptual business process modelling languages. Paper presented at the ACM Symposium on Applied Computing, Dijon, France.

Loos, P., & Fettke, P. (2001). Towards an integration of business process modeling and object-oriented software development. Paper presented at the Fifth International Symposium on Economic Informatics, Bucharest, Romania.

Loos, P., Fettke, P., Weißenberger, B. E., Zelewski, S., Heinzl, A., Frank, U., & Iivari, J. (2011). What in fact is the role of stylized facts in fundamental research of business and information systems engineering? Business and Information Systems Engineering, 3(2), 107-117.

Lorena, A., Marques, G. M., Kooijman, S. A. L. M., & Sousa, T. (2010). Stylized facts in microalgal growth: interpretation in a dynamic energy budget context. Philosophical Transaction of the Royal Society B, 365, 3509–3521.

Lübke, D., Marx Gómez, J., & Schneider, K. (2005). Serviceorientierte Architekturen und Prozessmanagement. ERP Management, 3, 19-22.

Lux, T., & Schornstein, S. (2005). Genetic learning as an explanation of stylized facts for foreign exchange markets. Journal of Mathematical Economics, 41(1-2), 169-196.

Mendling, J., Brabenetz, A., & Neumann, G. (2004). Generating SVG graphics from EPML processes. Paper presented at the EPK 2004—Geschäftsprozessmanagement mit Ereignisgesteuerten Prozessketten, Proceedings des GI-Workshops und Arbeitskreistreffens, Luxemburg, Luxembourg.

Mendling, J., & Nüttgens, M. (2003a). EPC modelling based on implicit arc types. Paper presented at the Information Systems Technology and its Applications, International Conference ISTA'2003, Kharkiv, Ukraine.

Mendling, J., & Nüttgens, M. (2003b). EPC syntax validation with XML schema languages. Paper presented at the EPK 2003—Geschäftsprozessmanagement mit Ereignisgesteuerten Prozessketten, Proceedings des GI-Workshops und Arbeitskreistreffens, Bamberg, Germany.

Mendling, J., & Nüttgens, M. (2003c). Konzeption eines XML-basierten Austauschformates für Ereignisgesteuerte Prozessketten (EPK). Informationssystem Architekturen, Wirtschaftsinformatik Rundbrief der GI Fachgruppe WI-MobIS 10 (2003) 2.

Mendling, J., & Nüttgens, M. (2003d). XML-basierte Geschäftsprozessmodellierung. Paper presented at the 6th Internationalen Tagung Wirtschaftsinformatik 2003: Medien - Märkte Mobilität, Dresden, Germany.

Mendling, J., & van der Aalst, W. M. P. (2006). Towards EPC semantics based on state and context. Paper presented at the EPK 2006—Geschäftsprozessmanagement mit Ereignisgesteuerten Prozessketten, Proceedings des GI-Workshops und Arbeitskreistreffens, Wien, Austria.

Mendling, J., van Dongen, B. F., & van der Aalst, W. M. P. (2007). On the degree of behavioral similarity between business process models. Paper presented at the EPK 2007—Geschäftsprozessmanagement mit Ereignisgesteuerten Prozessketten, Proceedings des GI-Workshops und Arbeitskreistreffens, St. Augustin, Germany.

Mendling, J., Verbeek, H. M. W., van Dongen, B. F., van der Aalst, W. M. P., & Neumann, G. (2008). Detection and prediction of errors in EPCs of the SAP reference model. Data & Knowledge Engineering, 64(1), 312-329.

Mendling, J., & Ziemann, J. (2005). Transformation of BPEL processes to EPCs. Paper presented at the EPK 2005—Geschäftsprozessmanagement mit Ereignisgesteuerten Prozessketten, Proceedings des GI-Workshops und Arbeitskreistreffens, Hamburg, Germany.

Merton, R. K. (1968). Social theory and social structure. New York: Free Press.

Moldt, D., & Rodenhagen, J. (2000). Ereignisgesteuerte Prozeßketten und Petrinetze zur Modellierung von Workflows. Paper presented at the Visuelle Verhaltensmodellierung verteilter und nebenläufiger Software-Systeme, Proceedings des 8. Workshop des Arbeitskreises "Grundlagen objektorientierter Modellierung" (GROOM) der GI-Fachgruppe 2.1.9 ("Objektorientierte Softwareentwicklung"), Bericht Nr. 24/00-I, Münster, Germany.

Nüttgens, M., & Rump, F. J. (2002). Syntax und Semantik Ereignisgesteuerter Prozessketten (EPK). Paper presented at the Promise 2002—Prozessorientierte Methoden und Werkzeuge für die

Entwicklung von Informationssystemen, Proceedings des GI-Workshops und Fachgruppentreffens, Potsdam, Germany.

Ozturk, I. (2010). A literature survey on energy-growth nexus. Energy Policy, 38(1), 340-349.

Petsch, M., Schorcht, H., Nissen, V., & Himmelreich, K. (2008). Ein Transformationsmodell zur Überführung von Prozessmodellen in eine Simulationsumgebung. Paper presented at the MobIS 2008—Modellierung betrieblicher Informationssysteme – Modellierung zwischen SOA und Compliance Management, Saarbrücken, Germany.

Phillips, A. W. (1958). The relationship between unemployment and the rate of change of money wages in the United Kingdom 1861-1957. Economica, 25(100), 283-299.

Popper, K. R. (1959). The logic of scientific discovery (2. ed.). London: Hutchinson.

Pries-Heje, J., & Baskerville, R. (2008). The design theory nexus. MIS Quarterly, 32(4), 731-755.

Recker, J., Rosemann, M., Indulska, M., & Green, P. (2009). Business process modeling - A comparative analysis. Journal of the Association for Information Systems, 10(4), 333-363.

Reiter, M., Fettke, P., & Loos, P. (2013). A contribution to theory building for the successful implementation of ERP and BPR – An application of the method of stylized facts. Paper presented at the 46th Hawaii International Conference on System Sciences (HICSS-46), Maui, USA.

Rittgen, P. (2000a). EMC - A modeling method for developing web-based applications. Paper presented at the International Conference of the International Resources Management Association (IRMA) 2000, Anchorage, Alaska, USA.

Rittgen, P. (2000b). Paving the road to business process automation. Paper presented at the European Conference on Information Systems (ECIS) 2000, Vienna, Austria.

Rittgen, P. (2000c). Quo vadis EPK in ARIS? Ansätze zu syntaktischen Erweiterungen und einer formalen Semantik. Wirtschaftsinformatik, 42(1), 27-35.

Rodenhagen, J. (2002). Ereignisgesteuerte Prozessketten (EPK) — Multiinstanziierungsfähigkeit und referentielle Persistenz. Paper presented at the EPK 2002—Geschäftsprozessmanagement mit Ereignisgesteuerten Prozessketten, Proceedings des GI-Workshops und Arbeitskreistreffens, Trier, Germany.

Rosenthal, R. (1991). Meta-analytic procedure for social research. Beverly Hills: Sage.

Sacks, D. W., Stevenson, B., & Wolfers, J. (2012). The new stylized facts about income and subjective well-being. Emotion, 12(6), 1181-1187.

Sarshar, K., & Loos, P. (2005a). Comparing the control-flow of EPC and Petri net from the end-user perspective. In W. M. P. van der Aalst, B. Benatallah, F. Casati & F. Curbera (Eds.), Business Process Management. LNCS 3649 (pp. 434-439). Berlin: Springer.

Sarshar, K., & Loos, P. (2005b). Modellierung überbetrieblicher Behandlungsprozesse durch Objekt-Petrinetze. Wirtschaftsinformatik, 47(3), 203-210.

Scheer, A.-W. (1998). ARIS – Business process modeling (2. ed.). Berlin: Springer.

Scheer, A.-W., & Thomas, O. (2005). Geschäftsprozessmodellierung mit der ereignisgesteuerten Prozesskette. Das Wirtschaftsstudium, 34(8-9), 1069-1078.

Schmidt, W., Fleischmann, A., & Gilbert, O. (2009). Subjektorientiertes Geschäftsprozessmanagement. HMD—Praxis der Wirtschaftsinformatik, 266, 52-62.

Schneider, K., & Schreiner, P. (2003). Ein methodischer Ansatz zur Messung der Kundenintegration in der Dienstleistungserbringung. Information Management & Consulting, 18(3), 51-57.

Schwerin, J. (2001). Dynamic of growth in transformational economies (in German). Köln: Böhlau.

Seel, C., & Vanderhaeghen, D. (2005). Meta-model based extensions of the EPC for inter-organisational process modelling. Paper presented at the EPK 2005—Geschäftsprozessmanagement mit Ereignisgesteuerten Prozessketten, Proceedings des GI-Workshops und Arbeitskreistreffens, Hamburg, Germany.

Seidlmeier, H., & Scherfler, G. (2007). Modellgetriebene Integration und Migration - vom Fachprozess zur ausführbaren Anwendung. HMD—Praxis der Wirtschaftsinformatik, 257, 93-105.

Simon, C., Freiheit, J., & Olbrich, S. (2006). Using BPEL processes defined by event-driven process chains. Paper presented at the EPK 2006—Geschäftsprozessmanagement mit Ereignisgesteuerten Prozessketten, Proceedings des GI-Workshops und Arbeitskreistreffens, Wien, Austria.

Simon, H. A. (1996). The sciences of the artificial (3rd ed.). Cambridge: MIT Press.

Sloman, A. (1978). The computer revolution in philosophy: Philosophy, science and models of mind. Hassocks, Sussex, England: Harvester.

Snidal, D. (2008). Commentary on the special issue. Journal of Conflict Resolution, 52(2), 326-333.

Störrle, H. (2006). A comparison of (e)EPCs and UML 2 activity diagrams. Paper presented at the EPK 2006—Geschäftsprozessmanagement mit Ereignisgesteuerten Prozessketten, Proceedings des GI-Workshops und Arbeitskreistreffens, Wien, Austria.

Sutton, R. I., & Staw, B. M. (1995). What theory is not. Administrative Science Quarterly, 40(3), 371-384.

Thagard, P. (1988). Computational philosophy of science. Cambridge: MIT Press.

Thomas, O., & Dollmann, T. (2006). Fuzzy-EPK-Modelle: Attributierung und Regelintegration. Paper presented at the EPK 2006—Geschäftsprozessmanagement mit Ereignisgesteuerten Prozessketten, Proceedings des GI-Workshops und Arbeitskreistreffens, Wien, Austria.

Thomas, O., & Fellmann, M. (2006). Semantische Integration von Ontologien und Ereignisgesteuerten Prozessketten. Paper presented at the EPK 2006—Geschäftsprozessmanagement mit Ereignisgesteuerten Prozessketten, Proceedings des GI-Workshops und Arbeitskreistreffens, Wien, Austria.

Thomas, O., Hüsselmann, C., & Adam, O. (2002). Fuzzy-Ereignisgesteuerte Prozessketten – Geschäftsprozessmodellierung unter Berücksichtigung unscharfer Daten. Paper presented at the EPK 2002—Geschäftsprozessmanagement mit Ereignisgesteuerten Prozessketten, Proceedings des GI-Workshops und Arbeitskreistreffens, Trier, Germany.

Thomas, O., Kaffai, B., & Loos, P. (2005). Referenzmodellbasiertes Event-Management mit Ereignisgesteuerten Prozessketten. Paper presented at the EPK 2005—Geschäftsprozessmanagement mit Ereignisgesteuerten Prozessketten, Proceedings des GI-Workshops und Arbeitskreistreffens, Hamburg, Germany.

Thomas, O., Seel, C., Seel, C., Kaffai, B., & Martin, G. (2004). EPK-Referenzmodelle für Verwaltungsverfahren. Paper presented at the EPK 2004—Geschäftsprozessmanagement mit Ereignisgesteuerten Prozessketten, Proceedings des GI-Workshops und Arbeitskreistreffens, Luxemburg, Luxembourg.

Treiber, M., Kesting, A., & Helbing, D. (2010). Three-phase traffic theory and two-phase models with a fundamental diagram in the light of empirical stylized facts. Transportation Research Part B, 44(8-9), 983-1000.

van der Aalst, W. M. P. (1999). Formalization and verification of event-driven process chains. Information & Software Technology, 41(10), 639-650.

van der Aalst, W. M. P., Desel, J., & Kindler, E. (2002). On the semantics of EPCs: A vicious circle. Paper presented at the EPK 2002—Geschäftsprozessmanagement mit Ereignisgesteuerten Prozessketten, Proceedings des GI-Workshops und Arbeitskreistreffens, Trier, Germany.

van Dongen, B. F., & Jansen-Vullers, M. H. (2005). EPC verification in the ARIS for MySAP reference model database. Paper presented at the EPK 2005—Geschäftsprozessmanagement mit Ereignisgesteuerten Prozessketten, Proceedings des GI-Workshops und Arbeitskreistreffens, Hamburg, Germany.

van Dongen, B. F., Jansen-Vullers, M. H., Verbeek, H. M. W., & van der Aalst, W. M. P. (2007). Verification of the SAP reference models using EPC reduction, state-space analysis, and invariants. Computers in Industry, 58(6), 578-601.

van Hee, K., Oanea, O., & Sidorova, N. (2005). Colored Petri nets to verify extended event-driven process chains. In R. Meersman & Z. Tari (Eds.), On the Move to Meaningful Internet Systems 2005: CoopIS, DOA, and ODBASE, LNCS 3760 (pp. 183-201). Berlin: Springer.

vom Brocke, J., Simons, A., Niehaves, B., Riemer, K., Plattfaut, R., & Cleven, A. (2009a). Reconstructing the giant: On the importance of rigour in documenting the literature search process. Paper presented at the European Conference on Information Systems (ECIS), Verona, Italy.

vom Brocke, J., Sonnenberg, C., & Simons, A. (2009b). Wertorientierte Gestaltung von Informations-systemen: Konzeption und Anwendung einer Potenzialmodellierung am Beispiel Serviceorientierter Architekturen. Wirtschaftsinformatik, 51(3), 261-272.

Walls, J., Widmeyer, G., & Sawy, O. E. (1992). Building an information systems design theory for vigilant EIS. Information Systems Research, 3(1), 36-59.

Webster, J., & Watson, R. T. (2002). Analyzing the past to prepare for the future: Writing a literature review. MIS Quarterly, 26(2), xiii-xxiii.

Wehler, J. (2007). Boolean and free-choice semantics of event-driven process chains. Paper presented at the EPK 2007—Geschäftsprozessmanagement mit Ereignisgesteuerten Prozessketten, Proceedings des GI-Workshops und Arbeitskreistreffens, St. Augustin, Germany.

Weick, K. E. (1989). Theory construction as disciplined imagination. Academy of Management Review, 14(4), 516-531.

Weißenberger, B. E., & Löhr, B. W. (2007). Planning and organizational success: Stylized facts of the empirical controlling research in Germany from 1990 - 2007 (in German). Zeitschrift für Planung & Unternehmenssteuerung, 18(4), 335-363.

Whetten, D. A. (1989). What constitutes a theoretical contribution? Academy of Management Review, 14(4), 490-495.

Wolfswinkel, J. F., Furtmueller, E., & Wilderom, C. P. M. (2013). Using grounded theory as a method for rigorously reviewing literature. European Journal of Information Systems, 22(1), 45-55.

Yousafzai, S. Y., Foxall, G. R., & Pallister, J. G. (2007). Technology acceptance: a meta-analysis of the TAM. Journal of Modelling in Management, 2(3), 251-304.

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