Journal of Enterprise Information Management

Integrating cloud computing in supply chain processes: A comprehensive literature review

Andreas Jede Frank Teuteberg

Received 28 August 2014
Revised 5 December 2014
5 May 2015
Accepted 22 May 2015

Integrating cloud computing in supply chain processes

A comprehensive literature review

Andreas Jede and Frank Teuteberg
Department of Accounting and Information Systems, University of Osnabrueck, Osnabrueck, Germany

Abstract

Purpose – There are cloud computing (CC) services available for various applications within supply chain management (SCM) processes and related enterprise information systems (ISs). These services offer, for example, consistent global networking platforms and shared real-time information. Furthermore, they enable quick decision making and ensure efficiency, which may strengthen competitive advantages as to digital processes within the supply chain (SC). However, research lacks a paper that systematically analyzes the interrelation between CC and SCM in detail and aims to become a reference point in the intersection of both research fields. Moreover, the purpose of this paper is to gain a deep understanding of the current state of research and to identify future research challenges.
Design/methodology/approach – This paper provides a cross-discipline systematic literature review from the research perspectives of ISs and SCM. In total, 99 papers have been investigated by combining qualitative and quantitative content analysis. As a side effect the authors developed a new methodological framework for conducting comprehensive literature reviews that could be applied by future research.
Finding – The authors discover the most important influence factors for CC implementations in SC processes and pay special attention to major issues, research methods, applied theoretical concepts, and geographical differences. Until now, SCM research in the realm of CC usage is still in its infancy both in theory and practice.
Research limitations/implications – Possibly not all of the relevant papers have been filtered during the paper selection phase. The findings of the literature review and the conceptual framework identifying different areas of concern are believed to be useful for future research to obtain an overview of the evolution of CC in SC processes.
Originality/value – To the best of the knowledge, there is no systematic literature review that consistently focusses CC usage within SC processes while integrating strategic aspects. Additionally, the authors constructed and applied a unique keyword analysis.

Keywords Systematic literature review, Cloud computing, Supply chain management, Content analysis
Paper type Literature review

1. Introduction and motivation

Already in the mid-1980s, Porter and Millar (1985) justified the outstanding importance of information technology (IT) for the value chain and thus for SCM. Even today, IT is essential for information visibility and flexibility along the entire supply chain (SC), supporting SC integration (Cegielski *et al.*, 2012; Steinfield *et al.*, 2011). With the introduction of traditional enterprise resource planning (ERP) systems, it was noted that they have limited progress for SCM (Akkermans *et al.*, 2003). They are lacking in providing effective SCM support especially due to their insufficient functionality in cross-organizational flows as well as their closed non-modular system architectures, and their inflexibility in ever-changing SC needs. With service-oriented architectures (SOA), which may originate from various vendors, the technical conditions have been created in order to provide complete services from encapsulated functions at any

Journal of Enterprise Information Management
Vol. 28 No. 6, 2015
pp. 872-904

1741-0398
DOI 10.1108/JEIM-08-2014-0085

location and any time (Bardhan *et al.*, 2010). Based on SOA, at the end of the last decade, the paradigm of "cloud computing" has emerged. Cloud computing (CC) offers significant advantages particularly for the decentralized and loosely coupled nature of global SCs, due to the fact that IT processes are becoming more and more stable and flexible, e.g., through scalability and virtualization (Bharadwaj *et al.*, 2013; Hoberg *et al.*, 2012; Pereira, 2009).

Looking at the provider side, SAP (www.sap.com), for example, already offers eight different CC services for SC-related IT processes like B2B trading, procurement, and information interchange. According to its own statement, GT Nexus (www.gtnexus.com) has the biggest CC-based global SC network that is accessed by more than 25,000 organizations including reputable firms like Hewlett & Packard, Procter & Gamble, and United Parcel Service. Beyond, eBuilder (www.ebuilder.com) represents an example of an order fulfillment service specialist that provides CC services for inbound, outbound, distribution, and reverse logistics and is used by organizations like DHL, Volvo, and the Swedish tax agency.

Cooper *et al.* (1997) define SCM as "the integration of key business processes from end user through original suppliers that provides products, services, and information that add value for customers and other stakeholders." In parallel to material flows and cooperation, a demand-oriented intra- and inter-organizational information supply is needed. Thus the challenge lies in selecting, adapting, and using suitable IT solutions. Here is the starting point of CC. The National Institute of Standards and Technology (NIST) defines CC as "a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction" (Mell and Grance, 2011). But CC does not represent a new technology. Rather, it stands for a new paradigm for IT processes (Youseff *et al.*, 2008) by consistently linking individual, existing technologies (Leimeister *et al.*, 2010). The majority of the research literature distinguishes between three service models (Hoberg *et al.*, 2012; Mell and Grance, 2011): "Infrastructure as a Service (IaaS)," "Platform as a Service (PaaS)," and "Software as a Service (SaaS)."

We are motivated by the fact that the obviously existing advantages of CC usage at SC processes lack a profound theoretical basis, since the current research is at an early stage in both theory and practice (Marston *et al.*, 2011). There is, however, a general consensus that CC has an IT scope on the one side and commercial administration relevance on the other side (Marston *et al.*, 2011). Currently, companies that need to combine these two aspects at the phases of selection, adaptation, usage, and possibly transition out, see themselves confronted with a confusing amount of CC options and concepts (Wind *et al.*, 2012). So far, the majority of scientific publications focus especially on the technical aspects (Böhm *et al.*, 2010; Fremdt *et al.*, 2013). Inter-disciplinary recommendations for specific strategic business areas (Hoberg *et al.*, 2012), such as SCM (Blau *et al.*, 2009; Leimeister *et al.*, 2010), are scarce. Further, scientific literature needs to focus more on relevant implementation factors and the strategic influence of CC in organizations (Marston *et al.*, 2011).

Since CC offers significant advantages regarding stability and flexibility particularly for the decentralized and loosely coupled nature of global SCs and for big data analytics in SCs, we carried out a systematic literature analysis. We are driven by the motivation to reunite the existing research on CC and SCM and to uncover more research gaps in literature by quantitative and qualitative data analysis. Further, our

review fulfills the requirements for investigating CC in more an inter-disciplinary context (Bardhan *et al.*, 2010) by moving in the intersection of the science disciplines information systems (IS) and SCM. Herein, this paper focusses on efficiency-related influence factors and intends to support the establishment of the needed research basis. The following research questions (RQ) will be addressed:

RQ1. What are the currently discussed (region-specific) core research topics with regard to CC in the realm of SCM?

RQ2. How are these topics connected to the most important and efficiency-related influence factors for adopting CC within the SC?

The paper is built up as follows: after the introduction, the methodology of the literature analysis is described in the second section. The results from the literature review are presented and discussed in Section 3. The paper closes with a conclusion in Section 4.

2. Methodology

This paper is based on the method of a systematic literature analysis, which has proven useful for the identification of the respective current status in scientific research (Fettke, 2006; Levy and Ellis, 2006). Furthermore, we followed the framework of Dibbern *et al.* (2004) during the classification phase of the individual paper. Based on the framework (cf. Table I), we pursued a systematic knowledge building that is strictly linked to the published articles. The execution of the analysis is closely related to the five-stage model of Fettke (2006). Both, the framework by Dibbern *et al.* (2004) as well as the model by Fettke (2006) constitute valuable and well-known methodologies in the context of systematic literature analyses. The five-stage model consists of issue description and definition of the research field, literature search, literature evaluation, literature analysis, and interpretation. For the keyword-based literature search at the second stage, we considered 33 top rated IS journals and 31 top rated SCM journals, that were derived from selected journal rankings. While IS research is covered by the rankings of the "Association for Information Systems" and "Wirtschaftsinformatik," the ranking "Transport, Logistics and SCM" of the University of Sydney is, according to our knowledge, the most comprehensive one in the field of SCM. In addition,

Phase	Stage	Research question/content	Section
Motivation	Why?	Why CC within the SC?	1
Scope, applied methods, and theories	What?	What are the descriptive statistics of the research field?	3.1
	How?	What are the major research topics?	3.2
	Which?	Do IS and SCM research view the underlying topic differently?	3.3
		What are the interrelations of the most discussed terms?	3.3
		What are the main influence factors for CC implementation?	3.3
		What are the empirically tested preconditions across various regions?	3.4
		Which research methods were used?	3.5
Implications	Outcome	What are the implications for theory and practice?	4

Table I.
Framework of analysis

four high-quality IS conferences (i.e. ICIS, ECIS, AMCIS, and WI) expanded the selection. Herein, we identified 63 relevant papers. These papers served as basis for forward and backward search and led to additional 36 papers. Hence, the total number of considered papers amounts 99 (cf. Appendix Table I for details of the applied five-stage model, Table II for the selected journals and conferences, and Table III for the used keywords).

During the literature search phase within the 63 journals and four conferences, we identified four papers that also applied a literature review in content-related topics. These papers are listed in Table II. They are sorted by the criteria: considered "Period," number of "Papers," "Research Questions," and "Results." Our work distinguishes from

Reference	Period	Papers	Research questions	Results
Hoberg *et al.* (2012)	1952-2011	60	What are the relevant aspects in the CC paradigm and how are these aspects characterized in the science literature?	Findings are compiled in four dimensions: general CC properties, determinants that influences CC adoption, required governmental regulations, and impact on entrepreneurship
Giménez and Lourenço (2008)	1995-2005	174	Which business processes benefit most from the internet?	Competitive advantages for companies arise in particular in the electronic procurement process, the order fulfillment process and the information flow
Salleh *et al.* (2012)	–	45	Which companies benefit from a CC enterprise system?	In particular, small- and medium-sized companies benefit most from CC because of low investments and limited IT resources
Fremdt *et al.* (2013)	2007-2011	28	How does CC affected operational agility?	"SaaS" based processes improve operational agility, but not immediately, e.g., through improved ERP and process support systems

Table II.
Related articles

Journal/conference	No.	%
American Conference on Information Systems	12	12.1
Decision Support Systems	8	8.1
European Conference on Information Systems	7	7.1
International Journal of Information Management	6	6.1
Communications of the ACM	3	3.0
International Conference on Information Systems	3	3.0
Information Systems Research	3	3.0
Journal of Management Information Systems	3	3.0
Pacific Conference on Information Systems	3	3.0
Transactions on Intelligent Transportation Systems	2	2.0
International Journal of Physical Distribution & Logistics Management	2	2.0
International Journal of Production Economics	2	2.0
Journal of Operations Management	2	2.0
Management Information Systems Quarterly	2	2.0

Table III.
Source of publication

the existing scientific literature for the following reasons. To our knowledge, there is up to date no systematic analysis of the literature that consistently focusses the CC usage within SC processes (while integrating strategic aspects). Three of the stated references that conduct a literature review on CC as well have strong IS focus and a minor meaning for SCM research (Hoberg *et al.*, 2012; Salleh *et al.*, 2012; Fremdt *et al.*, 2013). Contrary, the fourth paper by Giménez and Lourenço (2008) has a strong SCM regard but deals with pre-CC online solutions (and hence older publications). In addition, we present the most important influence factors for CC implementation in SCM by evaluating them qualitatively as well as quantitatively. Compared with the three actual reviews on CC, the focus on business processes in this literature sample is even higher due to considering SCM research, which normally addresses processes at economic-driven industries and companies, where business process thinking and acting is a primal principle.

3. Literature analysis and synthesis

The findings of this study are presented under different sub-sections. Each of the five sub-sections discusses the findings in relation to a particular topic. The topics are as follows: descriptive statistics (Section 3.1), most important keywords (Section 3.2), quantitative content analysis (Section 3.3), implications from the regions (Section 3.4), and applied research methods (Section 3.5).

3.1 Descriptive statistics

The analysis of publishing outlets (cf. Table III) on the underlying research topic indicated that relevant papers have been published more often on conferences like AMCIS (No. 12), ECIS (No. 7), and ICIS (No. 3). Moreover, the journals *Decision Support Systems* (No. 8) and *International Journal of Information Systems* (No. 6) published a remarkable amount as well and enriched the research field more than other journals. However, 39 journals published just one article (not shown in Table III). In total, 55 different sources were used for publishing the identified 99 articles (every percentage in Table III is from the total range of 99 articles).

Further, we tried to figure out the most prolific authors publishing CC papers in the realm of supply chain management (SCM). In Table IV, it is visible that Alexander Benlian and Haluk Demirkan both contributed four research papers followed by Benjamin T. Hazen, Helmut Krcmar, Holger Schrödl, Jörg Leukel, and Stephan Olariu with three papers each. In total, 21 authors published two papers. The overall analysis indicated that the topic has generally a wide author basis with 219 various researchers (every percentage in Table IV is from the total range of 219 authors).

In addition, we were interested in the frequency of publications per year. Hence, we analyzed articles from the years 2007 to 2013, since the term "Cloud Computing" appeared in scientific literature for the first time in 2007. Table V presents the frequency of research papers published along the underlying years. The rapidly increasing amount of papers indicated the growing interest for the topic and there are no early symptoms for a break of the general trend.

In order to get a geographic overview of the underlying topic, we analyzed the number of the publications per country based on the selected sample that exclusively contains papers in English language. The decisive factor herein is the institution of a paper's first author. The corresponding values are shown in Table VI. Our findings suggest that literature is dominated by two countries, namely the USA and Germany, since 58.6 percent of all papers originate in these countries. Comparing the two countries in detail,

Name	No.	%
Alexander Benlian	4	1.6
Haluk Demirkan	4	1.6
Benjamin T. Hazen	3	1.2
Helmut Krcmar	3	1.2
Holger Schrödl	3	1.2
Joerg Leukel	3	1.2
Stephan Olariu	3	1.2
Ali Syed Imran	2	0.8
Benjamin Fabian	2	0.8
Casey G. Cegielski	2	0.8
Charles Steinfield	2	0.8
Christoph Dorsch	2	0.8
Oliver Günther	2	0.8
Henning Baars	2	0.8
Hing Kai Chan	2	0.8
Jonas Repschlaeger	2	0.8
Kieran Conboy	2	0.8
Lorraine Morgan	2	0.8
M. Lynne Markus	2	0.8
Markus Böhm	2	0.8
Rolf T. Wigand	2	0.8
Rüdiger Zarnekow	2	0.8
Stefan Bensch	2	0.8
Stefan Wind	2	0.8
Stefanie Leimeister	2	0.8
Subhajyoti Bandyopadhyay	2	0.8
Thomas Hess	2	0.8
Yun Wu	2	0.8

Table IV.
Authors ranking

Year	No.	%
2007	0	0.0
2008	2	2.0
2009	5	5.1
2010	15	15.2
2011	19	19.2
2012	22	22.2
2013	36	36.4

Table V.
Publication per year

Germany is recognized as one of the leading nations in SCM and transportation research. And some authors argue that SCM is Germany's secret to its economic success (BME, Bundesverband für Material, Einkauf und Logistik e.V., 2013; Böhmer, 2005; PriceWaterhouseCoopers, 2011; Wagner, 2008). The USA is ahead of the other nations with regard to practical CC implementation experience. Additionally, the NIST published a CC roadmap in order to provide technical leadership for the USA (Hogan *et al.*, 2011).

3.2 Keyword analysis

Generally, scientific journals and conferences require keywords within the submitting process, which encapsulate and represent the fundamental content of the underlying paper.

Year	No.	%
Germany	29	29.3
USA	29	29.3
China incl. Hong Kong	10	10.1
UK	8	8.1
Australia	3	3.0
Swiss	3	3.0
Korea	2	2.0
The Netherlands	2	2.0
Saudi Arabia	2	2.0
Belgium	1	1.0
Canada	1	1.0
Iran	1	1.0
Kuwait	1	1.0
New Zealand	1	1.0
Poland	1	1.0
Portugal	1	1.0
Singapore	1	1.0
South Africa	1	1.0
Spain	1	1.0
Turkey	1	1.0

Table VI. Institution affiliation according to country

Therefore, we took into account just the keywords of the selected papers in order to get a better understanding for the main research topics and issues in the conjoint field of CC and SCM. In particular, we were interested in the interconnection of the keywords. First, we will explain the underlying methodology of the keyword analysis and thereafter the outcome.

In ten of the publications there were no keywords. In the remaining 89 papers, we found 472 keywords in total, which means an average of 5.3 keywords per paper. Given this starting point, we executed four clustering stages with the aim to aggregate the data content and reduce the total amount. In the first stage, we standardized the different variants of spelling, namely upper and lower case letters, hyphens, as well as separate, and compound words (e.g. "Service-oriented," "service-oriented," and "service oriented"). At this grammatical stage, we reduced the amount to 325 keywords. In the next stage, we unified keywords with the same meaning, and wrote abbreviations in full (e.g. "SCM" and "Supply Chain Management," or "Cloud" and "Cloud Computing"). Thereby, the number of keywords decreased to 261. The third stage covered the highest analytical work load, as we merged keywords of the same content (e.g. "inter-firm," "inter-company," "inter-operation," "inter-organization") or ("Logistics Management," "Supply Chain Management," "Supply Network Management"). At this stage, we had to check the deeper meaning of ambiguous keywords in the corresponding papers' content. Within the third stage, our clear intention was to reduce the keywords to a well-manageable quantity. Therefore, we also grouped closely related words and marked them with "&" (e.g. "Coordination & Collaboration"). Furthermore, we grouped specific research theories, which all were stated as single keywords, to one general term, and we did the same with the research methodology keywords. Thus, we aggregated the keywords to 62. During the final stage, which served as a kind of filter, we deleted all keywords with just one or two occurrences as we deduced a minor relevance for our analysis (e.g. "Durable Goods,"

"Consumerization"). As a result, the four-stage clustering process led to a relevant amount of 47 keywords.

In the following step, we traced back the 47 defined keywords to their initial papers and positions and built a tool based on MS Excel that counted the amount of every emerging keyword combination. The underlying algorithm for the tool is described in the following:

(1) Let us assume that we are given a random sample of I scientific papers. Our goal is to perform a keyword classification of the sample, which is assumed to be based only on the keywords of the papers. In the following, we explain the employed classification method in detail.

(2) We assume that the set of all N_i keywords $p_j^{(i)}, 1 \leqslant j \leqslant N_i$, related to the ith paper is denoted by:

$$M_i := \left\{p_1^{(i)}, p_2^{(i)}, \ldots, p_{N_i}^{(i)}\right\}.$$

In particular, the keywords are assumed to be alphabetically ordered, which we symbolically express by the following relations:

$$p_j^{(i)} <_{\text{ABC}} p_{j+1}^{(i)} \forall\, i \in \{1, \ldots, I\}, j \in \{1, \ldots, N_i - 1\}.$$

(3) For the classification, we consider the set T_i of all possible 2 tuples, that can be created from the elements of M_i, and where the 2-tuple elements are alphabetically ordered, i.e.:

$$T_i := \left\{\left(p_j^{(i)}, p_k^{(i)}\right) \middle| 1 \leqslant j, k \leqslant N_i, j < k\right\}.$$

(4) The alphabetical order of the 2-tuple elements simplifies the classification by providing an unambiguous representation for each combination of two keywords.

(5) In a next step, we create the disjoint union T of all 2-tuple sets T_i, which is defined as follows:

$$T := \coprod_{i=1}^{I} T_i := \cup_{i=1}^{I} \{(t, i) | t \in T_i\}.$$

In particular, an element of T consists of a keyword 2-tuple and the respective paper index.

(6) The motivation behind the look at the disjoint union of all keyword 2 tuples is to have the possibility to count the occurrence of all possible 2 tuples within the underlying paper sample. In particular, the number of occurrences of a 2-tuple (p, q) with $p <_{\text{ABC}} q$ is determined by the number $C_{p,q}$ of elements of the following set:

$$T^{(p,q)} := \{(t, i) \in T | t = (p, q)\},$$

where:

$$C_{p,q} := |T^{(p,q)}|.$$

These numbers of occurrences of certain keyword 2 tuples provide coarse information about which topics are addressed in which context and to what extent by the papers within the sample.

(7) To better illustrate relevance of the addressed topics, it is reasonable to first sort all the N pair-wise different keywords of the paper sample according to the total number of keyword 2 tuples they occur in. The total number L_p of keyword 2 tuples, in which a certain keyword p occurs, is given by:

$$L_p := \sum\nolimits_{q >_{\text{ABC}} p} C_{p,q} + \sum\nolimits_{q >_{\text{ABC}} p} C_{q,p}.$$

Hence, the sorted keywords, which shall here be denoted by p_j, $1 \leqslant j \leqslant N$, satisfy the following condition:

$$L_{p_j} > L_{p_{j+1}} \; \forall \, 1 \leqslant j \leqslant N-1.$$

Second, the numbers of occurrences of certain keyword 2 tuples may be normalized by the total number C of occurrences of all keyword 2 tuples:

$$C := \sum\nolimits_p \sum\nolimits_{q >_{\text{ABC}} p} C_{p,q}.$$

The resulting relative numbers of occurrence may then be arranged in the matrix:

$$\mathbf{A} := \begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & A_{p_{N-1},p_N} \\ 0 & 0 & \iddots & \iddots & \vdots \\ 0 & 0 & A_{p_2,p_3} & \dots & A_{p_2,p_N} \\ 0 & A_{p_1,p_2} & A_{p_1,p_3} & \dots & A_{p_1,p_N} \end{bmatrix},$$

whose elements are defined by:

$$A_{p_j,p_l} := \begin{cases} C_{p_j,p_l}/C, & \text{if} \quad p_j <_{\text{ABC}} p_l \\ C_{p_l,p_j}/C, & \text{else} \end{cases}.$$

The matrix $\mathbf{A}$, together with the labels of the rows of columns, finally provides a possible keyword classification of the paper sample. In particular, the labels of the more upper rows indicate the most relevant topics by means of the respective keywords. The matrix elements indicate the relative relevance of topic combinations.

It becomes apparent in Figure 1 that SCM sets up on specific advantages that CC claims to offer. This type of advantages is related to "Coordination & Collaboration," "Inter-organizational Systems," and "Customer Partnering Relationship" and will be investigated deeper in the upcoming sub-sections. Nonetheless, the keyword analysis indicates the early phase where the underlying research field is situated, due to researchers still focus primary "IT-Adoption & Integration" and "System Selection & Evaluation." Post-implementation-related factors like CC-satisfaction or non-financial

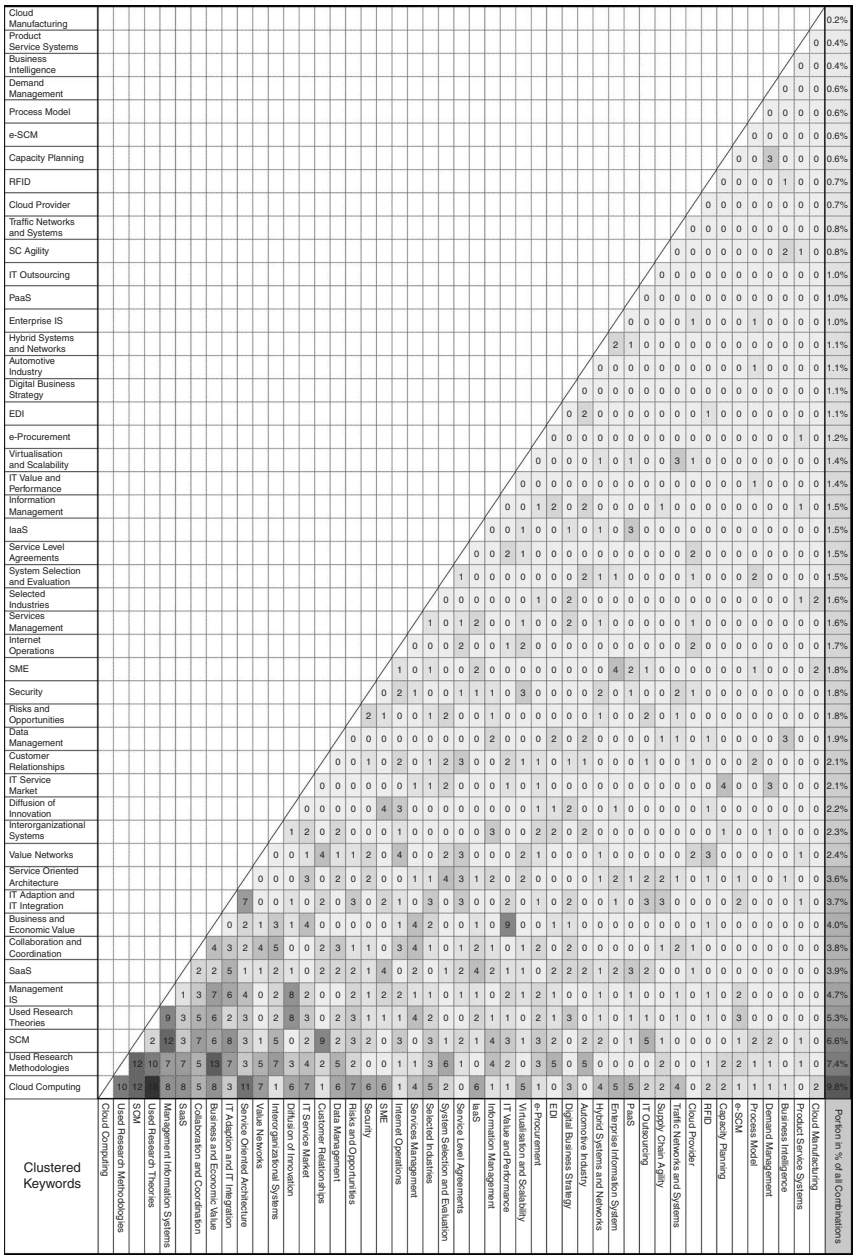

Figure 1.
Bird's eye view on research field

success measures are mostly missing, because this presupposes the existence of broad CC adoption experiences in theory and praxis.

We expected "CC" and "SCM" to be frequently involved in combinations, but surprisingly "Business & Economic Value" in conjunction with "Research Methodologies" had the second highest combination value with 13 hits. As stated previously, research

literature investigated CC mostly from the technical lens. It seems that research is progressing onward to identify factors that may create business value (e.g. Chang and Wills, 2013; Hazen and Byrd, 2012; Hoberg *et al.*, 2012).

Comparing the three service models, we indeed expected SaaS to be the most common model, and according to Figure 1, the service model SaaS is dominating the literature sample strongly. Numerous works in the sample, although differentiating between service models, focus their research explicitly on SaaS. The overweight could possibly be justified by the fact that SaaS usually serves as a "front-end" for the end user (Huang *et al.*, 2013; Youseff *et al.*, 2008). Thus, compared with IaaS and PaaS, SaaS might be the only "visible" CC contact for the end user.

The terms "Research Methodologies" and "Research Theories" both belong to the top five keywords in Figure 1. While the research theories will be presented in detail later on in Section 3.5, in the following we will shift our focus to research methods. Table VII provides an overview of the used methods of the sample. Since 19 of the 99 articles used two methods, the total number of methods equals 118. We identified seven different methods (Wilde and Hess, 2007), which were used for the classification of the papers.

Hence, argumentative/deductive research occurred largely in 43 percent of the papers. Within the cross-sectional analysis, empirical surveys occurred twice as often as interviews. A further structuring of the 118 used methods into the "design science paradigm" and the "behavioral science paradigm" by Wilde and Hess (2007) revealed a significant surplus of 62 percent of the first alternative. The ratio is an indicator of the early stage of the research field, because behavioral work in general requires the presence of artifacts as a basis for investigation of behavioral science studies and is used increasingly at advanced research fields (Martens and Teuteberg, 2009). But the ratio along the underlying years (2007-2013) is getting more balanced and the development of the research field is visibly in progress. For example, almost half of all cross-sectional analyses were published in 2013. For understanding and assessing the specific relationships within the investigated research field even better, underrepresented methods, and multi-method approaches should gain more attention.

3.3 Quantitative data analysis and empirical findings

In the prior keyword analysis we investigated the interconnections of the keywords on an overriding level. Now, our objective for the data analysis is to identify the detailed relationships and find hidden features (Sullivan, 2001) of the sample's entire content. The three goals and instruments are stated in Table VIII. When following the third goal by identifying the main influence factors, we will augment the quantitative results with the existing empirical findings even if there is a limited amount of empirical papers (cf. Table VII).

Table VII. Applied research methods

Research method	No.	%
Argumentative/deductive research	51	43.2
Cross-sectional survey and interviews	36	30.5
Reference modeling	11	9.3
Case study	8	6.8
Simulation	6	5.1
Prototyping	5	4.2
Experiment	1	0.8

According to Lijphart (1971), content analysis is a suitable methodology for theory development especially in research fields that lack a theoretical background, like the underlying topic. Herein, content analysis of textual messages has to fulfill eight requirements (Neuendorf, 2002), which are defined as: objectivity, inter-subjectivity, a priori design, reliability, validity, generalizability, replicability, and hypothesis testing. To address the eight requirements and foster the transparency in the analysis as well, we applied a process based on a flow model, which is visible in Figure 2. During data processing in accordance to the flow model, we used a special document mining software called "WordStat" that is an extension of "QDA Miner" (Provalis, 2010).

To prepare the software-based analysis, the sample documents are copied directly into the software QDA Miner, whose add-on WordStat is used for quantitative analysis. Before starting with the analysis in the third stage, two preliminary stages require preparation (first stage) and pre-processing (second stage). The first stage, preparation, consists of checking the spelling of the individual documents, removal of hyphens and

Goals	Instruments
(1) Identify main co-occurences	Dendrogram
(2) Compare disciplinary views on research topic	Heat-map
(3) Identify main influence factors	Term frequency
	Proximity plot
	TF IDF

Table VIII. Goals and instruments

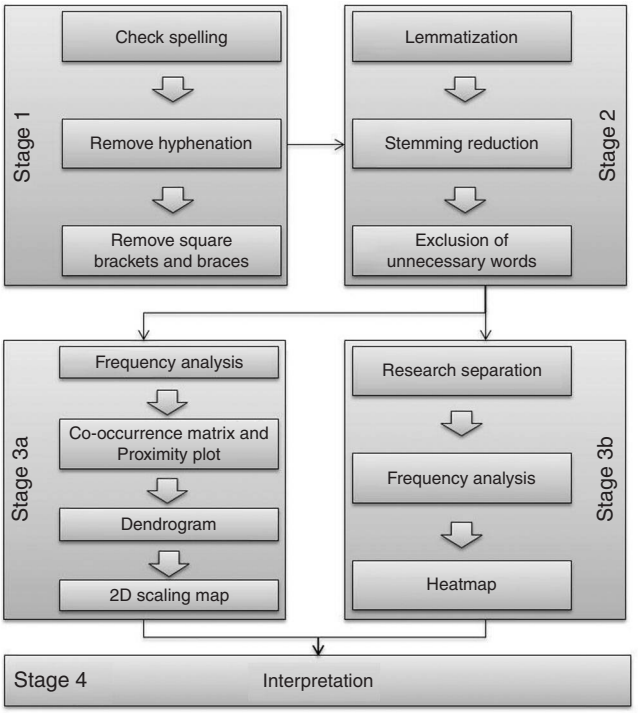

Figure 2. Process of software-based analysis

hyphenation and the removal of brackets and braces, which is a special feature within the software for excluding/including certain text segments. Therefore, misspelled words and inconsistencies in hyphenations, and the presence of brackets and braces can cause misleading conclusions.

For pre-processing the documents for the software-based analysis, we made use of a generally accepted process in the second stage (Sidorova *et al.*, 2008). We started with lemmatization, a procedure in which all plural forms are transferred into the singular and all the verbs from the past tense are taken into in the present tense. Thereafter, the stem-form reduction is performed, a process in which different nouns, verbs, adjectives, and adverbs that belong to the same root word are transformed into a single word without suffixes and prefixes. This step eliminates one of the biggest issues of the quantitative content analysis, namely, the existence of synonyms and of identical terms with different spellings (Martens *et al.*, 2011; Freundlieb and Teuteberg, 2013). For example, the words management, managing, manage, and manager have been reduced to MANAG. In the last step of the second stage, the exclusion dictionary, also known as a stop list, is used to remove all words with little or no semantic value like the and any. Additional information resulting from the two stages is shown in Table IX.

In the third stage, our aim was twofold. On the one side (Stage 3a), clarification of the content relationships, and on the other side (Stage 3b), discovering the word frequency variations in contents between IS and SCM research within the sample size.

The word frequencies indicate how often a single word appears absolutely or relatively in the analyzed text passages, whereas with the help of co-occurrence, the conjoint appearance of two words (1:1) can be analyzed and transferred into a proximity plot. Using this information, dendrograms can be derived. They provide information about words mentioned in connection with independent variables (1:*n*). These results can be visualized (Provalis, 2010) by means of a 2D scaling map (cf. Appendix Figure 1 for details on 2D scaling map). For analyzing these interrelations, the Jaccard's index (JI) similarity coefficient was used. This simple measure is reasonable especially for word analysis within a sample (Murguía and Villaseñor, 2003; Tan *et al.*, 2005) and is defined by:

$$J = \frac{a}{a+b+c}$$

where a represents a document's paragraph in which both words occur, and b and c represent paragraphs in which one word is found but not the other (Tan *et al.*, 2005). In a parallel process, we separated the 21 SCM papers from the 78 IS papers. The word frequencies were analyzed by research field. We reunited the outcomes and put them into a heat-map, where word frequencies are represented by different tone levels (Provalis, 2010).

Table IX.
Statistics of the quantitative data analysis

Statistics	Value
Total number words	686,433
Excluded words (in %)	318,167 (46.4%)
Total number of sentences	30,359
Words per sentence	22.6
Total number of paragraphs	34,385
Words per paragraph	20.0

We tried to figure out the parallelism between IS and SCM research via a "Heat-map" in order to identify the similarities and differences of the two research fields (Stage 3b). We used the 60 most commonly occurring words as a basis and transformed their appearance into a percentage by dividing the word frequency by the total number of words of both independent fields. Then, the word distribution among the both fields is transferred into color scale, where bright red means a high percentage and dark blue a relatively low percentage (cf. Appendix Figure 2 for the heat-map). Terms like "CLOUD & COMPUT," "INFORM & SYSTEM," "SERVIC & PROVID," and "SUPPLI & CHAIN & MANAG" are frequently mentioned in both research fields. However, SCM research has a stronger process orientation with regards to cause and effect (PROCESS, CHANG, RELATIONSSHIP, ORDER, TIME) and is often speaking in more general terms (TECHNOLOGI, CLOUD) instead of specific technical aspects (SAAS, SOFTWAR, DATA, APPLIC, INFRASTRUCTUR). Therefore, it is not surprising, that managing these unspecified aspects in order to realize the mentioned opportunities mostly with the help of models (MODEL) is viewed as a complicated operation (COMPLEX) from SCM point of view.

As can be deduced from partly resembling colors, there are some similar understandings with regards to the common research field. Interestingly, both fields elaborate the CC provider role (PROVID) more often than the user role (USER), which is contrary to the fact that only 2 percent of the papers are written from the provider side. This indicates that users are mainly in a claiming position and have process requirements and needs that providers have to fulfill. More attention should be paid to necessary changes at own IT processes and organizational structures.

As we are strongly interested in the initial reasons for CC adoption, we tried to figure out the most discussed influence factors of the whole sample (cf. Appendix Table IV for the absolute frequencies of word stems occurring in the studied sample). Given the object of investigation, it is not surprising that the word stems CLOUD, SERVIC, and SUPPLI, CHAIN, MANAG appear relatively frequently. Further, the vast amount of the sample explores the adoption (ADOP) and integration (INTEGR) of CC at SC business processes (BUS, PROCESS) within firms (FIRM), companies (COMPANI), and organizations (ORGAN). Next, we will investigate three emerged influence factors:

(1) Cost reduction (frequency: 1,888).

The most discussed factor is related to COST/TIME reduction. This factor refers to the cost leadership concept by Porter (1980) and aims to have the lowest operational IT-costs in the industry at equal IT service quality. In this context and with regards to economizing opportunistic behaviors of transacting partners (Wiliamson, 1981), also the "transaction cost theory" is valid. Depending on the industry sector (excluding the IT-industry), IT-costs account for up to 10 percent of the revenues with increasing percentage rates over years and suffer from low-cost transparency (PriceWaterhouseCoopers, 2009), which leads to the implication of a high-cost reduction potential. Especially since the financial crisis in 2008, companies more than ever strive for economic flexibility. And as IT-costs normally belong to period expenses, they are under close investigation by top-management anyway. Research literature has proven the potential total cost of ownership benefits of SaaS compared to traditional on-premise IT (Benlian, 2009; Bibi *et al.*, 2012) and further, cross-sectional surveys and expert interviews indicate a pre-existing cost reduction potential for specific SC processes as well (e.g. Garrison *et al.*, 2012; Venters and Whitley, 2012; Alshamaila *et al.*, 2013). Morgan and Conboy (2013) investigated three case companies

and note that the companies have lowered costs for servers, licenses, maintenance, back-ups, and electricity. But they also state that there may be hidden costs such as additional trainings. Therefore, the widely cited implicit assumption of a quasi-automatic reduction of costs by adopting CC (Bensch, 2012; Schrödl, 2012; Wind *et al.*, 2012) has to be viewed more critically, since only Meer *et al.* (2012) have proven a beneficial cost effect under real circumstances for SCM by observing transport distribution processes. They improved the scalability of the data layer in online multi-tier applications by routing a request to a database instance that can process it with a minimal amount of work. In general, preventing capital expenditures (depreciations), administrative costs on the user side sounds favorable, but the increased cost dependency on the provider has to be taken into account, as contracts are mostly planned long term (Demirkan *et al.*, 2010) due to high switching costs. Further, the (short term) freedom of choice for the frequency of upgrades and downgrades depending on the economic situation is given away. Future research should investigate these economic dependency effects in more detail in order to provide decision support for practice:

(2) IT-value increase (frequency: 1,742).

The second most often mentioned influence factor refers to the need of IT-value increase and higher IT-performance with the usage of CC (VALU, PERFORM). In this context, adaptors expect a high level of support (LEVEL, SUPPORT), high-speed data access, functional coverage, add-on services, customizability, latest hard, and software, as well as service bundles (Li *et al.*, 2012; Wind *et al.*, 2012). Here, one of the few empirical works was written by Wu *et al.* (2013), who analyzed the CC support in aspects of SC ISs infrastructure. They state that organizations with more complex business processes might find that CC offers a functional advantage over traditional IT solutions and is more compatible with their information processing requirements, which would in turn enhance their propensity to adopt CC services. Ziekow *et al.* (2010) investigated a radio-frequency identification (RFID) cloud service for high-speed data access in distributed SCs. With their data-on-network experiments they reduced request concurrency by distributing load and reduced network delay by providing RFID data via short network paths. But their paradigm can result in long response times for data access. Li *et al.* (2012) focus the CC implementation in small/medium cold chain logistics companies via a formal model. They conclude that CC can help small/medium cold chain logistics companies to achieve a high-quality IT service with minimal investment, enabling these enterprises to obtain IT services at a large enterprise level. Generally, the factor IT-value is highly related to the cost benefits factor, since the CC provider compensates the above average IT-value services with cost increases. As is valid for the factor "costs," the factor "IT-value increase" is missing even more evidence from practical research:

(3) IT-security increase/decrease (frequency: 1,249).

IT-security (SECUR) is in third place and is discussed controversially in the sample, as it may increase and decrease depending on the initial status. By providing a massive concentration of data through the internet, adopting companies arouse the attention of hackers (European Network and Information Security Agency, 2009). Contrary, a high level of data security is depending on financial investments and security know-how (Kaufman, 2009), which can better be managed by CC-providers like Amazon or Microsoft than, e.g. by a small logistics company, as the established CC-providers gain

from economies of scale (Brender and Markov, 2013). But in the great majority of the papers, data security is discussed as a risk. And most of the cross-sectional survey (cf. Table VII) hypothesize conflicting relations between IT-security and CC adoptions (e.g. Gupta *et al.*, 2013; Lee *et al.*, 2013; Benlian and Hess, 2011). Durowoju *et al.* (2011) focus security and how it can impact the SC operations using entropy as an assessment tool. They prove that CC is just advantageous for SC partners under the conditions of high security. Demirkan and Goul (2013) addressed transitioning multiple, collaborating organizations to what can be referred to as a "value-network" CC. They propose a cloud service broker model from the view point of the service provider in order to be able to run secure business process executions of an entire value network. In a transportation case study Yan *et al.* (2013) describe a model where vehicles automatically form a cloud by connecting virtual cells, which can be a group of vehicles. They ensure protection against security attacks in vehicular clouds due to an algorithm that enhances authentication of high-mobility vehicles.

Private CC provides the highest security level, but is detrimental to costs and IT-value as the mentioned benefits cannot appear (e.g. no up-front costs). Therefore, the three implementation factors must always be considered together and the interrelationship between them should be studied in detail with valid measures.

After having identified the influence factors costs, IT-value, and security, we were interested in their main co-occurrence topics in order to investigate the specific risks and opportunities especially for SCM more closely. The below stated Figure 3 was calculated with the use of JI by computing the top 30 co-occurrences based on the three identified factors. For example, the highest JI is given to the co-occurrence (VALU > NETWORK; JI: 0.599). Thereafter, the other two factors with the pre-defined co-occurrence topic "NETWORK" are computed: (COST > NETWORK; JI: 0.219) and (SECUR > NETWORK; JI: 0.402). This distribution in percentage is shown in the Figure 3. The co-occurrence (COST > TIME; JI: 0.552) has the second highest rate and is therefore ranked second and so forth. Most of the co-occurrence topics are pre-defined by the factor cost, which again indicates the dominant position this factor holds:

(4) Value – networks (JI: 0.599).

Value networks are often understood as a network of suppliers, distributors, and customers that are connected via electronic media like CC to create ideally values for their end customers and the network members. Thereby, the strategic key component is the digital procurement process (Bensch, 2012; Tapscott *et al.*, 2000). To ensure smooth processes across this network, the participants should implement adequate technical services, since a chain is only as strong as its weakest member. Further, by integrating other SC members into the CC network, an adequate orchestration of digital processes and a suitable interface configuration is required. Also the question, how to model product-service bundles (VALU > PRODUCT; JI: 0.433) and procurement recommender systems, especially with CC-based components in value networks (Bensch, 2012; Schrödl, 2012), is of increasing scientific interest:

(5) Security – access (JI: 0.524).

By nature, security is closely related to data access and data networks (NETWORK; JI: 0.402) as well, since the data does not "sleep" within the companies' IT (at public CC). The ubiquitous feature of CC enables a fast access to any type of data, on any platform, using a wide range of interfaces, and data access standards by portioning data

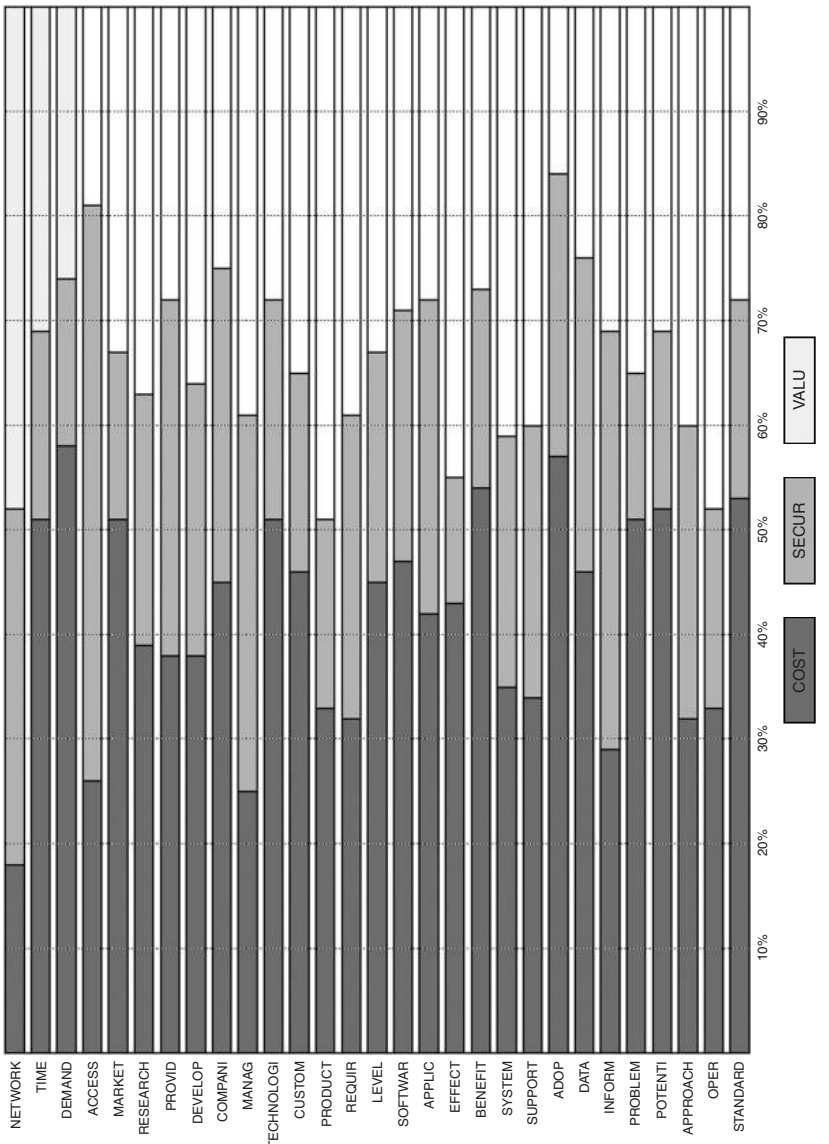

Figure 3.
Proximity plot of the factors costs, security, and value

in-memory across multiple servers (Yuhanna *et al.*, 2010; Gunawi *et al.*, 2011). Additionally, if a CC service acts as an interface with various customers (CUSTOM; JI: 0.181), e.g., by placing a manufacturing order directly, security breaches may appear within an inter-organizational SC (Durowoju *et al.*, 2011), especially when affected companies have risk policies with different security levels. Further risks may occur at the provider's data centers (PROVID; JI: 0.389) that are accessed by many independent users day by day (Nuseibeh, 2011):

(6) Cost – demand (JI: 0.542).

In addition to the above mentioned direct cost reduction potential, there is an indirect cost reduction opportunity by forcing inventory to a more demand-driven structure. Jones explained the stock out reduction and inventory turn rate increase at a grocery store, where suppliers were connected to a CC ordering process (Jones, 2011). Thus, demand management in combination with CC implicates improvements at the "Profit and Loss Statement" (lower interests) and higher cash flows. The indirect influence factors that may lead to the trailing effect of inventory reduction are discussed in the following.

Another way to determine the significance of a paper's words in a collection or corpus is the numerical statistic "term frequency – inverse document frequency (TF IDF)" (Salton and Buckley, 1988). Normally, this algorithm is used as a weighting factor to such an extent as it increases proportionally to the number of times a specific word appears in a single document, but decreases with the frequency of the word in the corpus. Although there were many modification models developed based on "TF-IDF," the initial search formula has proven extraordinarily robust (Berger *et al.*, 2000; Robertson, 2004; Salton and Buckley, 1988). The underlying assumption is: words with the highest TF-IDF are characterizing the papers' content based. The definition is as follows: if we denote the total amount of documents within the sample by $|D|$, a word by w, and an individual document by $d \varepsilon D$, we calculate (Salton and Buckley, 1988):

$$w_d = f_{w,d} \times \log \frac{|D|}{f_{w,D}}$$

where $f_{w,d}$ equals the number of times w appears in d and $f_{w,D}$ equals the number of documents in which w appears in D (cf. Appendix Table V for the ranking by TF IDF).

Coming back to the major influence factors for CC adoption, risks (RISK) and concerns with regards to IT-security (SECUR) still belong to the major topics. It is remarkable that with the use of TF IDF index, the SCM-specific influence factors are emerging. The three upcoming hidden influence factors are related to efficiency as well, since they may improve the material flows and the physical logistics service performance. Furthermore, these improvements within the inventory process may reduce the lagging financial indicator "working capital." These three factors refer to SC network flexibility and are interrelated to each other, too. However, Fremdt *et al.* (2013) describe an indirect leverage of CC. Thus, CC introduces an increased flexibility at the management level of information and this in turn positively affects the management level of material flows and physical cooperation. Compared to the factor cost, the flexibility-related arguments are multifaceted and multi-dimensional. Therefore, due to missing a single term, they are not listed in the simple frequency-term ranking. But taking all the upcoming arguments into account, increasing flexibility has the same relevance from the perspective of SCM as costs. Detached from our analysis, this result

is confirmed by the works of Venters and Whitley (2012), Cegielski *et al.* (2012), and Fremdt *et al.* (2013), who, independently from each other, came to the same conclusion through expert interviews:

(7) Agility (TF IDF: 223.1).

First, as SCs drift from traditional relationships to loosely coupled dynamic ecosystems (Bharadwaj *et al.*, 2013), the digital processes require increasing technical agility (AGIL) in order to respond quickly to changes in the environment (Blome *et al.*, 2014). The important role of agility for SCM has widely been showed as a key component for SC's success (Duclos *et al.*, 2003; Goldsby and Stank, 2000; Swafford *et al.*, 2006). By the means of CC, we pay special attention to interoperability, compatibility, configuration, deployment, portability, scalability, virtualization, automation, and the standardization degree (Cegielski *et al.*, 2012; Wind *et al.*, 2012). Mainly focussing on electronic data interface (EDI), Gosain *et al.* (2004) showed that the ability of creating inter-organizational linkages (offering flexibility) and the ability to alter existing linkages (partnering flexibility) with different SC partners (adjusted by environmental needs) are crucial for overall SC success. This insight served as basis for Steinfield *et al.* (2011). In their automotive industry case study they analyzed cloud-based EDI systems in aspects of increasing standardization. Furthermore, they focus whether information flows sequentially in a point-to-point fashion among SC partners (like traditional EDI) or is provided simultaneously to relevant partners via a system hub. The study provided evidence that the standards and the shared hub approach addresses transparency problems in inter-organizational SCs. Leukel *et al.* (2011a) stated the question, how to distribute airline orders to grounded handling services at airport SCs best? They created a CC service with a standardized electronic interface that increased the accessibility of handling service providers and accomplished work load bottlenecks effectively:

(8) Coordination/collaboration (TF IDF: 125.3/91.5).

Second, a suitably degree of SC coordination and collaboration (COORDIN, COLLABOR) is primary an organizational challenge on employees' job level (e.g. creating workflows and enable communication within and across the company's boundaries). Here, information asymmetries in SCs hinder a single participant to create, propagate, and coordinate a production or distribution plan for the entire SC (Leukel *et al.*, 2011a). Therefore, collaboration and coordination willingness is a requirement for SC success. And CC can enforce transparency and a higher quality of data (Morgan and Conboy, 2013; Azevedo *et al.*, 2013) across SC partners. By involving SC partners, Pareto-efficient, IT-value networks may be created. Autry *et al.* (2010) and Liu *et al.* (2010) pointed out that eSCM's major benefit lies in the coordination and collaboration improvement, leading to a competitive advantage. Further, when using various CC-providers, another challenge is to design mechanisms with a stringent IT-coordination strategy for optimal service compositions (Blau *et al.*, 2009; Demirkan *et al.*, 2010; Leukel *et al.*, 2011a):

(9) Knowledge/sharing (TF IDF: 62.8/69.7).

Third, referring to the knowledge-based view (cf. Table I), CC supposes to indirectly offer a higher level of knowledge sharing with internal and external SC partners (KNOWLEDG, SHAR, PARTNER) by creating and transferring knowledge. This means in other words an integration of SC processes based on partnering relationship. SC literature has proven the advantageous effects of information and knowledge

sharing for all participating units within a SC network, especially with regards to minimize demand risks (Cachon and Fisher, 2000; Guo *et al.*, 2006) and the bullwhip effect (Lee *et al.*, 1997). In this context, CC acts as a medium for cross-organizational analysis of data, process planning, and finally decision support system (Cegielski *et al.*, 2012; Leukel *et al.*, 2011b), which can be aggregated to knowledge sharing. Leukel *et al.* (2011b) conducted an in-depth case study with a document management system (DMS) in SCM and found evidence that a cloud-based DMS service enables "knowledge extraction" and knowledge distribution across SCs. A CC platform for small manufacturing companies is proposed and tested by Huang *et al.* (2013). The platform facilitates to exploit and share the manufacturing information and manufacturing resources, improve operations management, and even promote design of products.

3.4 Implications from different regions

Technical, cultural, political, and economic differences between the regions can have a significant impact on the development of CC usage within SCM. Furthermore, we have shown through the quantitative analysis that the implementation reasons are multi-dimensional and not generalizable. Hence, we investigated all papers for country-specific preconditions in individual countries in order to find relations between implementation factors and premises for CC adoption. Most of the findings mentioned below stem from empirical surveys.

In China, the financing channels for small- and medium-sized entities are quite limited, and therefore management is unwilling to invest remarkable amounts in IT hardware and software (Li *et al.*, 2012). The rental model of CC can enhance the use of the latest IT without capital expenditure and provide transparency throughout SC processes as in particular the Chinese logistics infrastructure suffers from a low level (Li *et al.*, 2012). The Chinese authors emphasize potential data security increases from the use of CC since the logistics companies suffer from a low initial security level (Cho and Chan, 2013; Li *et al.*, 2012).

Picking up the traffic issues especially in Chinese metropolitan areas, Wang impressively demonstrated via prototyping that CC can enable a well-functioning smart intersection traffic-control system (Wang, 2010). The Chinese CC market is just emerging, as it lacks the relevant number of vendors and thus too few adopting companies (Cho and Chan, 2013). Additionally, the IT-staff ratio per company is significantly lower than in Europe or in the USA (Cho and Chan, 2013), which means that the companies meet the increasing demand for inter-organizational IT-process with limited IT capabilities (Xiao *et al.*, 2011). Considering these factors, the Chinese government, known to play a major role within the economy, established a well-known cloud service platform in order to gain from the mentioned opportunities (Huang *et al.*, 2013).

In South Korea, the SaaS market was also forced by the government with strong policies and SaaS quality certifications in order to develop a well-functioning SaaS market system (National Information Society Agency (NISA), 2008). But neither the certifications nor the introduced SaaS marketplace did foster remarkable progress. Via analytical hierarchy process in combination with a survey, Lee *et al.* (2013) figured out that South Korea has transformed from a policy-led to a customer-driven market, in which reduced costs and fast deployment possibilities have the strongest impact for companies to implement SaaS. They conclude that the big distrust in security is still a major barrier to catch up with the developed CC markets.

On the contrary, Central Europe has a well-established CC provider market (Repschlaeger *et al.*, 2012). However, compared to the US and Chinese entities, European

companies have a more risk averse mindset with regards to data security (Benlian, 2009; Gupta *et al.*, 2013). Especially valid for SME, adequate data protection regulations set by the European Union would increase CC reliability (Tarzey, 2012). In a large cross-sectional survey within German companies, Benlian and Hess (2011) also see security risks as the dominant influence factor for CC implementation, followed by performance and economic risks. On the other hand, they address the strongest SaaS opportunity factor to costs, which was followed by strategic flexibility and quality improvements. Generally, researchers see no difference between European companies' average knowledge and the current state of knowledge of the scientific literature (Alshamaila *et al.*, 2013; Benlian and Hess, 2011; Brender and Markov, 2013).

Compared to under-developed CC markets, which are mainly cost driven, the CC influence factors in companies in the USA are more granular, by taking into account factors like business process complexity, functionality, compatibility, and business culture as well (Wu *et al.*, 2013). Further, empirical surveys emphasized the CC importance for inter-organizational SC success within US-based companies (Cegielski *et al.*, 2012; Ranganathan *et al.*, 2013). Further, most of the biggest CC-providers like Amazon and Salesforce.com come from the USA. But the advanced usage of CC services confronts the US-companies with next level issues as they suffer from lower IT-performance (Compuware, 2011). And once again, the national government holds a leading position within a country as the US government is one of the biggest community- and hybrid-CC adapters, using various specific services and processing citizens' requests efficiently. Furthermore, federal, state, and local US governments are linked to each other through a cleverly designed hybrid-CC system (Gupta *et al.*, 2013; Marston *et al.*, 2011).

Although the examples given represent just a small subset of the sample, the overall evidence from literature is consistent with the distribution in Table VI: currently, Europe and North America are the leading regions in science and practice in the underlying field. Regardless of the respective development level, all regions mention cost reduction potential to be a major influential factor. This implicates that this factor may represent a fundamental baseline, before continued CC developments enable multi-dimensional benefits like flexibility increase and inter-organizational SC linkage. Furthermore, governments obviously play an interesting and important double-role in the CC-ecosystem. On the one side, especially in Central Europe, users expect them to take the regulatory role and to be a standard setting body that ensures high-data security. On the other side governments try to act as catalyzer that enforces CC development by deploying, providing, and using own CC services.

Disregarding the country-specific CC-premises, there are two principle ways evolving that governments pursue. Whereas in GBR and in the USA the governments cooperated with existing privately owned CC-providers (Chang and Wills, 2013; Maude, 2011; Marston *et al.*, 2011), the governments in South Korea and China funded organizational structures for providing completely own CC services (NISA, 2008; Huang *et al.*, 2013). Future research should further investigate this multiplicative dependency, especially the single and double loop learning possibilities as well as the adequate extent of activities for respective governments. In general, similarities, differences, and influence factors for specific regions may be a fruitful area for future research.

3.5 Applied theoretical concepts

As mentioned before the terms "Research Theories" belongs to the top five keywords within the sample (cf. Figure 1). In general, scientific theories represent the most reliable, rigorous, and comprehensive form of scientific knowledge (Schafersman, 1994).

In order to mature a research field, it is essential to understand a theory's foundation and also to adequately adopt the key content in order to extend the scientific knowledge. In this context, our study provided two outstanding points that suffer from the same reason: the high quantity and the wide variety of the used research theories. As the underlying research field, which is multi-disciplinary, has to be grounded in theory and is still searching for sustainable directions, researchers are exploring a broad range of mathematical, organizational, sociological, and psychological theories. Beside the occurrence of theories in defined keywords, we also entirely checked all papers for generally accepted theories through a qualitative investigation. The outcome is shown in Table X and is structured by a short theory description and the corresponding usage (stated as question) within the sample. Since no question is completely answered, this table can provide some ideas and may also serve as a starting point for future research.

4. Conclusions

4.1 Limitations

Like every scientific paper, the paper has potential limitations, too. Hence, during the paper selection phase (with the use of keywords) possibly not all of the relevant papers have been filtered. The three main reasons for this may be the incompleteness of the initially defined keywords, alternative terms, and names in relevant articles, and the limitation of pre-determined publication journals and conferences. Further, the IS and SCM portions are not balanced due to the majority of the 99 papers is derived from IS literature, whereas only 21 papers came from SCM literature. This is eminent especially for the comparison of the heat-map.

4.2 Implications for theory

We set out to conduct a comprehensive literature review on CC usage in SCM. From our point of view, the defined procedure of qualitative and quantitative content analysis is adequate for theory building. In particular, the keyword analysis in Section 3.2 represents a powerful tool for exploring a research field. Not surprisingly, there is a strong link between the papers' keywords and their entire content. Dominating keywords like coordination and collaboration constitute major implementation factors as well. It would be interesting to actualize the matrix along a timeline in order to observe the directions a research field takes. Emerged from the matrix and as stated above, the theory Table X may serve as starting point for future research. The diffusion of innovation theory has a leading position at the moment. For the future, combinations of adequate theories may be useful. Here, adaption from more developed research fields that operate with multi-theories and multi-research methods can be suitable.

We have seen that the research base is quite distributed by having 219 various researchers in 99 papers. Hence, the broad basis indicates broad application possibilities of CC in SCM. German and American researchers created almost 60 percent of all published papers in the sample. Furthermore, IS conferences show an increasing interest with regard to the underlying research field. Unfortunately, we could not found any valuable paper from SCM conferences. Furthermore, the vast amount of papers discusses the SC processes on the overall level. There are just a few papers that investigate specific SCM activities like procurement, inbound logistics, operations, inventory management, outbound logistics, distribution, or customer relationship management. Future research should analyze the implementation factors on individual activity level.

Theory	Short description	Usage in literature sample	References
Attention-Based View (ABV)	ABV is to explain how firms regulate and spread the attention of their decision makers (Ocasio, 1997)	How can CC channel CIOs attention on strategic business processes?	Malladi and Krishnan (2012)
Diffusion of Innovation Theory (DIT)	DIT, strongly dependent on human behavior, is defined as the process by which an innovation is communicated through certain channels among the participants of an organization over time (Rogers, 2003)	How does the implementation and use of a SaaS ERP system (with a SCM module) influences the process performance at a small company, where IT knowledge is strongly limited?	Wu *et al.* (2013); Seethamraju (2013)
Game Theory (GT)	GT is about mathematical models of conflict and cooperation between decision makers with imperfect information (Myerson, 1991)	How to model coordination strategies in a SaaS supply chain consisting of application service providers and application infrastructure providers?	Xiao *et al.* (2011); Demirkan *et al.* (2010)
Information Processing Theory (IPV)	Grounded in psychology, IPV takes into account the increasing internal and external task uncertainty and suggests that rational organizations pursue the systematical progression for decision-making support (Galbraith, 1974)	How to link a company's information processing requirements and capabilities to influence the intention to implement CC as an enabler of SCM?	Cegielski *et al.* (2012); Wu *et al.* (2013)
Knowledge-Based View (KBV)	KBV suggests that gaining competitiveness is depending on the firm's ability to create and transfer knowledge, which is consisting of know-how and information (Kogut and Zander, 1992)	How to positively influence SC flexibility through both internal and external knowledge transfer?	Blome *et al.* (2014)
Prospect Theory (PT)	PT is a behavioral probabilistic model about the overweighting of negative but improbable outcomes, owing to rational decision makers who rather refer to personal heuristics that are based on the potential value of gains and losses instead of concentrating on final outcomes (Kahneman and Tversky, 1979)	Question just stated as future research: how to explain the risk aversion of the CC adoption decision especially with the aid of PT? How to involve partner companies and share information?	Cegielski *et al.* (2012)
Queuing Theory (QT)	QT is a mathematical model to forecast queue lengths and waiting times at production systems, transportation and stocking systems, communication systems, and information processing systems (Adan and Resing, 2002)	How to evaluate and select the adequate CC provider for SC business functions in order to get the desired level of flexibility by the means of scalability?	Durowoju *et al.* (2011)

Table X.
Theories and their usage within the literature sample

(*continued*)

Theory	Short description	Usage in literature sample	References
Real Option Valuation (ROV)	ROV applies financial options theory to quantify the strategic value of decision flexibility with respect to investment projects under uncertain conditions (Borison, 2003)	How to develop a formal eSCM framework that will allow for enhanced communication in the supply chain, thereby increasing information flow?	Zandi *et al.* (2013)
Resource-Based View (RBV)	RBV of the firm suggests that financial resources may be utilized to gain competitive advantage; but just in case the firm implements a value creating strategy that is not being implemented by current or potential competitors (Barney, 1991) (closely related to RDT)	How to combine SCM-IT with positive buyer-supplier relationships in a way that forces innovation?	Hazen and Byrd (2012); Schniederjans and Özpolat (2013)
Resource Dependence Theory (RDT)	RDT suggests that the environments of organizations have a major influence on the behavior of the organization. Multi-dimensional resources could have internal and external characteristics, e.g., employee, capital, raw material (Pfeffer and Salancik, 1978)	How to explain organizations' willingness to control over and own inter-organizational IS, knowing that this procedure is the main reason for system failure? How to understand the IT-Outsourcing decision through the lens of RDT?	Nuseibeh (2011); Chatterjee and Ravichandran (2013)
Social Capital Theory (SCT)	Based on sociology research, SCT suggests that advantages derived from relationships between companies can be intangible and tangible types, including those that are psychological, social, emotional, and economic in the short- and long-term (Lin, 2001)	How to understand the relationship between collaboration and flexibility at humanitarian logistics with CC adoption, and the effect of inter-organizational trust on this relationship?	Schniederjans and Özpolat (2013)
Socio-Technical Systems Theory (STS)	STS focusses on organizations' workplaces and suggests that technical improvements do not necessarily lead to superior overall outputs due to complex socio-technical interaction (Trist and Bamforth, 1951)	How does a new SCM system implementation affect employees' perceptions of changes in their work process complexity and rigidity? How does this system influence job satisfaction, job concerns, and quality performance?	Bala (2013)
Technology Acceptance Model (TAM)	TAM is an information system-based theory and assumes that the user appreciation for a new technology is depending on the factors "perceived usefulness" and "perceived ease-of-use" (Davis, 1989)	What are the relationships between a company's perceived usefulness as well as perceived ease of use and a company's purpose to adopt a new supply chain system in technologically complex environments? Which effect has the company's IT knowledge?	Autry *et al.* (2010)

(*continued*)

Table X.

Theory	Short description	Usage in literature sample	References
Theory of Reasoned Action (TRA)	Grounded in social psychology, TRA constitutes a prediction model that investigates the coherence of beliefs, attitudes, intentions, and behaviors (Fishbein and Ajzen, 1975)	How do SaaS adopters and non-adopters compare regarding their risk/ opportunity judgment? What are logistics managers' perceptions of cloud computing?	Benlian and Hess (2011); Aviles *et al.* (2012)
Transaction Cost Theory (TCT)	TCT explores the two organizational alternatives, do it yourself or buy from an external supplier, and therefore TCT helps to define the efficient organization boundaries. Transaction costs are the costs affiliated with organizational structure, financials, and contractual law (Williamson, 1981)	How to provide companies with decision support in IT-outsourcing assessment? What impact does application specificity, environmental uncertainty (incl. SC uncertainty), usage frequency, and firm size have on CC adoption?	Nuseibeh (2011); Benlian (2009)
Two Factor Theory (TFT)	TFT is about that job motivators (e.g. responsibility, recognition, and advancement) give positive satisfaction whereas hygiene factors (e.g. salary, status, and security) results in dissatisfaction from their absence (Herzberg, 1968)	How to classify the SaaS market into adoption-driving and adoption-inhibiting factors? What are the relevant factors for a successful SaaS market? Why do employees perceive radical changes when collaborating with partner companies via CC?	Lee *et al.* (2013)

Table X.

We would like to take the mentioned imbalance for motivating SCM research to investigate the "CC" paradigm and to no longer undervalue possible opportunities. Especially, we have seen that on the one hand more technical investigation is needed from a process-oriented perspective and on the other hand research should focus more on empirical investigations in order to understand and enlarge knowledge about reality interconnections. As mentioned prior, traditional ERP systems cannot provide SCM progress accordingly (Akkermans *et al.*, 2003) and CC has the potential to address key SCM concerns.

4.3 Implications for practice

Considering the most important influence factors, we have found that costs reduction, IT-value increase, and security represent three general factors that are SCM relevant but not SCM specific. The three additionally identified factors agility, coordination/ collaboration, and knowledge/information sharing address specific SCM issues and trends such as standardization across SCs, growing transparency between across related companies, and the demand for flexible and stable SCs. But the flexibility gains increase through CC with the increase of complexity of IT processes (Cegielski *et al.*, 2012; Swafford *et al.*, 2008). However, these complicated IT integration processes require a higher internal planning and implementation effort, which can offset the other advantages such as costs. Up to now, research investigates mostly argumentatively the preconditions, the risks, and the opportunities. The next step for scientific research and especially for practice should remark the definition of qualitative and quantitative CC-KPI for specific influence factors, service models, deployments, and business fields such SCM.

4.4 Outlook

Based on a systematic literature review, we presented the actual state of CC usage in SC processes. The outcomes indicate that the linkage between CC and SCM will get stronger in future. Further, we believe that practice has not realized the full potential of this connection up to now and theory lacks both a general research basis and empirical SCM-related papers that ground on real application scenarios. By means of prototyping, expert interviews, action research, and further empirical studies the underlying research field should be investigated more in detail. This will support managers and operational users to understand cross-organizational interconnections and facilitate necessary learning processes. At the same time, the compelling needed exchange of knowledge between theory and practice will be promoted.

References

The following reference list contains just sources that were explicitly cited within our paper. The complete literature sample reference list is available at: http://tinyurl.com/kx7xzv2

Adan, I. and Resing, J. (2002), "Queuing theory", available at: www.win.tue.nl/~iadan/queueing.pdf (accessed June 1, 2014).

Alshamaila, Y., Papagiannidis, S. and Li, F. (2013), "Cloud computing adoption by SMEs in the north east of England: a multi-perspective framework", *Journal of Enterprise Information Management*, Vol. 26 No. 3, pp. 250-275.

Akkermans, H.A., Bogerd, P., Yücesan, E. and Van Wassenhove, L.N. (2003), "The impact of ERP on supply chain management: exploratory findings from a European Delphi study", *European Journal of Operational Research*, Vol. 146 No. 2, pp. 284-301.

Autry, C.W., Grawe, S.J., Daugherty, P.J. and Richey, R.G. (2010), "The effects of technological turbulence and breadth on supply chain technology acceptance and adoption", *Journal of Operations Management*, Vol. 28 No. 6, pp. 522-536.

Aviles, M.E., Rutner, P. and Dick, G. (2012), "Logistics management: opportunities in the cloud", *Proceedings of the Southern Association of Information Systems Conference (SAIS), Atlanta, GA, March 23-24*.

Azevedo, S., Prata, P. and Fazendeiro, P. (2013), "Assessment of supply chain agility in a cloud computing-based framework", *Scalable Computing: Practice and Experience*, Vol. 13 No. 4, pp. 295-301.

Bala, H. (2013), "The effects of IT-enabled supply chain process change on job and process outcomes: a longitudinal investigation", *Journal of Operations Management*, Vol. 31 No. 6, pp. 450-473.

Bardhan, I.R., Demirkan, H., Kannan, P.K., Kauffman, R.J. and Sougstad, R. (2010), "An interdisciplinary perspective on IT services management and service science", *Journal of Management Information Systems*, Vol. 26 No. 4, pp. 13-64.

Barney, J. (1991), "Firm resources and sustained competitive advantage", *Journal of Management*, Vol. 17 No. 1, pp. 99-120.

Benlian, A. (2009), "A transaction cost theoretical analysis of software-as-a-service (SaaS)-based sourcing in SMBs and enterprises", *Proceedings of the 17th European Conference on Information Systems (ECIS), Verona, June 8-10, 2010*.

Benlian, A. and Hess, T. (2011), "Opportunities and risks of software-as-a-service: findings from a survey of IT executives", *Decision Support Systems*, Vol. 52 No. 1, pp. 232-246.

Bensch, S. (2012), "Recommender systems for strategic procurement in value networks", *Proceedings of the 18th American Conference on Information Systems (AMCIS), Seattle, Washington, August 9-11*.

Berger, A., Caruana, R., Cohn, D., Freitag, D. and Mittal, V. (2000), "Bridging the lexical chasm: statistical approaches to answer-finding", available at: http://ftp10.us.freebsd.org/users/azhang/disc/disc01/cd1/out/papers/sigir/ p192-berger.pdf (accessed July 2, 2014).

Bharadwaj, A., El-Sawy, O.A., Pavlou, P.A. and Venkatraman, N. (2013), "Digital business strategy: toward a next generation of insights", *Management Information Systems Quarterly*, Vol. 37 No. 2, pp. 471-482.

Bibi, S., Katsaros, D. and Bozamis, P. (2012), "Business application acquisition: on-premise or SaaS-based solutions?", *IEEE Software*, Vol. 29 No. 3, pp. 86-93.

Blau, B.S., Conte, T. and Meinl, T. (2009), "Coordinating service composition", *Proceedings of the 17th European Conference on Information Systems (ECIS), Verona, 8-10 June, 2010*.

Blome, C., Schoenherr, T. and Eckstein, D. (2014), "The impact of knowledge transfer and complexity on supply chain flexibility: a knowledge-based view", *International Journal of Production Economics*, Vol. 147 No. 1, pp. 307-316.

BME, Bundesverband für Material, Einkauf und Logistik e.V. (2013), "Deutschland bleibt führender Logistikstandort", available at: www.bme.de/Deutschland-bleibt-fuehrender-Logistikstandort.10058146.0.html (accessed August 1, 2014).

Böhmer, R. (2005), "Spezial logistik: leuchtendes vorbild", *Wirtschaftswoche*, Vol. 40 No. 29, pp. 54-65.

Böhm, M., Koleva, G., Leimeister, S., Riedl, C. and Krcmar, H. (2010), "Towards a generic value network for cloud computing", in Altmann, J. and Rana, O.F. (Eds), *Economics of Grids, Clouds, Systems, and Services*, Springer, Berlin and Heidelberg, pp. 129-140.

Borison, A. (2003), "Real Options Analysis: Where are the Emperor's Clothes?", available at: http://ardent.mit.edu/real_options/RO_current_lectures/borison.pdf (accessed June 1, 2014).

Brender, N. and Markov, I. (2013), "Risk perception and risk management in cloud computing: results from a case study of Swiss companies", *International Journal of Information Management*, Vol. 33 No. 5, pp. 726-733.

Cachon, G.P. and Fisher, M. (2000), "Supply chain inventory management and the value of shared information", *Management Science*, Vol. 46 No. 8, pp. 1032-1048.

Cegielski, C.G., Jones-Farmer, L.A., Wu, Y. and Hazen, B.T. (2012), "Adoption of cloud computing technologies in supply chains: an organizational information processing theory approach", *International Journal of Logistics Management*, Vol. 23 No. 2, pp. 184-211.

Chang, V. and Wills, G. (2013), "A university of greenwich case study of cloud computing", in Graham, D., Manikas, I. and Folinas, D. (Eds), *E-Logistics and E-Supply Chain Management: Applications for Evolving Business*, IGI Global, Hershey, PA, pp. 232-253.

Chatterjee, D. and Ravichandran, T. (2013), "Governance of interorganizational information systems: a resource dependence perspective", *Information Systems Research*, Vol. 24 No. 2, pp. 261-278.

Cho, V. and Chan, A. (2013), "An integrative framework of comparing SaaS adoption for core and non-core business operations: an empirical study on Hong Kong industries", *Information Systems Frontiers*, Vol. 17 No. 3, pp. 629-644.

Compuware (2011), "North American and European Businesses lose millions of revenue dollars yearly due to poor cloud performance", available at: http://investor.compuware.com/releasedetail.cfm?ReleaseID=553490 (accessed April 12, 2014).

Cooper, M.C., Lambert, D.M. and Pagh, J.D. (1997), "Supply chain management: more than a new name for logistics", *The International Journal of Logistics Management*, Vol. 8 No. 1, pp. 1-13.

Davis, F.D. (1989), "Perceived usefulness, perceived ease of use, and user acceptance of information technology", *Management Information Systems Quarterly*, Vol. 13 No. 3, pp. 319-340.

Demirkan, H. and Goul, M. (2013), "Taking value-networks to the cloud services: security services, semantics and service level agreements", *Information Systems and e-Business Management*, Vol. 11 No. 1, pp. 51-91.

Demirkan, H., Cheng, H.K. and Bandyopadhyay, S. (2010), "Coordination strategies in an SaaS supply chain", *Journal of Management Information Systems*, Vol. 26 No. 4, pp. 119-143.

Dibbern, J., Goles, T., Hirschheim, R. and Jayatilaka, B. (2004), "Information systems outsourcing: a survey and analysis of the literature", *ACM SIGMIS Database*, Vol. 35 No. 4, pp. 6-102.

Duclos, L.K., Vokurka, R.J. and Lummus, R.R. (2003), "A conceptual model of supply chain flexibility", *Industrial Management and Data Systems*, Vol. 103 No. 6, pp. 446-463.

Durowoju, O., Chan, H.K. and Wang, X. (2011), "The impact of security and scalability of cloud service on supply chain performance", *Journal of Electronic Commerce Research*, Vol. 12 No. 4, pp. 243-256.

European Network and Information Security Agency (2009), "Cloud computing: benefits, risks, and recommendations for information security", available at: www.enisa.europa.eu/activities/risk-management/files/deliverables/cloud-computing-risk-assessment (accessed August 12, 2014).

Fettke, P. (2006), "State-of-the-Art des State-of-the-Art: Eine Untersuchung der Forschungsmethode 'review' innerhalb der Wirtschaftsinformatik", *Wirtschaftsinformatik*, Vol. 48 No. 4, pp. 257-266.

Fishbein, M. and Ajzen, I. (1975), "Belief, attitude, intention, and behavior: an introduction to theory and research", available at: http://people.umass.edu/aizen/fanda1975.html (accessed July 1, 2014).

Fremdt, S., Beck, R. and Weber, S. (2013), "Does cloud computing matter? An analysis of the cloud model software-as-a-service and its impact on operational agility", *Proceedings of the 46th Hawaii International Conference on in System Sciences (HICSS), Grand Wailea, HI, January 7-10*.

Freundlieb, M. and Teuteberg, F. (2013), "Corporate social responsibility reporting – a transnational analysis of online corporate social responsibility reports by market-listed companies: contents and their evolution", *International Journal of Innovation and Sustainable Development*, Vol. 7 No. 1, pp. 1-26.

Galbraith, J.R. (1974), "Organization design: an information processing view", *Interfaces*, Vol. 4 No. 3, pp. 28-36.

Garrison, G., Kim, S. and Wakefield, R.L. (2012), "Success factors for deploying cloud computing", *Communications of the ACM*, Vol. 55 No. 9, pp. 62-68.

Giménez, C. and Lourenço, H.R. (2008), "E-SCM: internet's impact on supply chain processes", *The International Journal of Logistics Management*, Vol. 19 No. 3, pp. 309-343.

Goldsby, T.J. and Stank, T.P. (2000), "World class logistics performance and environmentally responsible logistics practices", *Journal of Business Logistics*, Vol. 21 No. 2, pp. 187-208.

Gosain, S., Malhotra, A. and El Sawy, A.O. (2004), "Coordinating for flexibility in e-business supply chains", *Journal of Management Information Systems*, Vol. 21 No. 3, pp. 7-45.

Guo, Z., Fang, F. and Whinston, A.B. (2006), "Supply chain information sharing in a macro prediction market", *Decision Support Systems*, Vol. 42 No. 3, pp. 1944-1958.

Gunawi, H.S., Do, T., Hellerstein, J.M., Stoica, I., Borthakur, D. and Robbin, J. (2011), "Failure as a service (FaaS): a cloud service for Large Scale", available at: www.eecs.berkeley.edu/Pubs/TechRpts/2011/ EECS-2011-87.pdf (accessed April 12, 2014).

Gupta, P., Seetharaman, A. and Raj, J.R. (2013), "The usage and adoption of cloud computing by small and medium businesses", *International Journal of Information Management*, Vol. 33 No. 5, pp. 861-874.

Hazen, B.T. and Byrd, T.A. (2012), "Toward creating competitive advantage with logistics information technology", *International Journal of Physical Distribution and Logistics Management*, Vol. 42 No. 1, pp. 8-35.

Herzberg, F. (1968), "One more time: how do you motivate employees?", *Harvard Business Review*, Vol. 46 No. 1, pp. 53-62.

Hoberg, P., Wollersheim, J. and Krcmar, H. (2012), "The business perspective on cloud computing – a literature review of research on cloud computing", *Proceedings of the 18th American Conference on Information Systems (AMCIS), Seattle, WA, August 9-11*.

Hogan, M., Liu, F., Sokol, A. and Tong, J. (2011), "Nist cloud computing standards roadmap", available at: www.miketib.com/coreplus/20110715%20NIST%20%20Cloud%20Computing%20Standards%20Roadmap_SP_500-291.pdf (accessed July 20, 2014).

Huang, B., Li, C., Yin, C. and Zhao, X. (2013), "Cloud manufacturing service platform for small- and medium-sized enterprises", *The International Journal of Advanced Manufacturing Technology*, Vol. 65 Nos 9-12, pp. 1261-1272.

Jones, S.D. (2011), "Cloud computing is changing how businesses work. KPMG finds", *The Wall Street Journal*, October 3.

Kahneman, D. and Tversky, A. (1979), "Prospect theory: an analysis of decision under risk", *Econometrica*, Vol. 47 No. 2, pp. 263-291.

Kaufman, L.M. (2009), "Data security in the world of cloud computing", *IEEE Security and Privacy*, Vol. 7 No. 4, pp. 61-64.

Kogut, B. and Zander, U. (1992), "Knowledge of the firm, combinative capabilities, and the replication of technology", *Organization Science*, Vol. 3 No. 3, pp. 383-397.

Lee, H.L., Padmanabhan, V. and Whang, S. (1997), "Information distortion in a supply chain: the bullwhip effect", *Management Science*, Vol. 43 No. 4, pp. 546-558.

Lee, S.G., Chae, S.H. and Cho, K.M. (2013), "Drivers and inhibitors of SaaS adoption in Korea", *International Journal of Information Management*, Vol. 33 No. 3, pp. 429-440.

Leimeister, S., Boehm, M., Riedl, C. and Krcmar, H. (2010), "The business perspective of cloud computing: actors, roles and value networks", *Proceedings of the 18th European Conference on Information Systems (ECIS), Pretoria, June 6-9*.

Leukel, J., Kirn, S. and Schlegel, T. (2011b), "Supply chain as a service: a cloud perspective on supply chain systems", *Systems Journal*, Vol. 5 No. 1, pp. 16-27.

Leukel, J., Jacob, A., Karaenke, P., Kirn, S. and Klein, A. (2011a), "Individualization of goods and services: towards a logistics knowledge infrastructure for agile supply chains", *AAAI Spring Symposium: AI for Business Agility, Palo Alto, CA, March 21-23*.

Levy, Y. and Ellis, T.J. (2006), "A systems approach to conduct an effective literature review in support of information systems research", *International Journal of an Emerging Transdiscipline*, Vol. 9 No. 1, pp. 181-212.

Li, X., Wang, Y. and Chen, X. (2012), "Cold chain logistics system based on cloud computing", *Concurrency and Computation: Practice and Experience*, Vol. 24 No. 17, pp. 2138-2150.

Lijphart, A. (1971), "Comparative politics and the comparative method", *American Political Science Review*, Vol. 65 No. 3, pp. 682-693.

Lin, N. (2001), *Social Capital*, Cambridge University Press, Cambridge, pp. 19-25.

Liu, H., Ke, W., Wei, K.K., Gu, J. and Chen, H. (2010), "The role of institutional pressures and organizational culture in the firm's intention to adopt internet-enabled supply chain management systems", *Journal of Operations Management*, Vol. 28 No. 5, pp. 372-384.

Malladi, S. and Krishnan, M.S. (2012), "Cloud computing adoption and its implications for cio strategic focus – an empirical analysis", *Proceedings of the 33rd International Conference on Information Systems (ICIS), Orlando, FL, December 16-19*.

Marston, S., Li, Z., Bandyopadhyay, S., Zhang, J. and Ghalsasi, A. (2011), "Cloud computing – the business perspective", *Decision Support Systems*, Vol. 51 No. 1, pp. 176-189.

Martens, B. and Teuteberg, F. (2009), "Why risk management matters in it outsourcing – a systematic literature review and elements of a research agenda", *Proceedings of the 17th European Conference on Information Systems (ECIS), Verona, June 8-10*.

Martens, B., Pöppelbuss, J. and Teuteberg, F. (2011), "Understanding the cloud computing ecosystem: results from a quantitative content analysis", *Proceedings of Wirtschaftsinformatik (WI), Zurich, February 16-18*.

Maude, F. (2011), "ICT strategy strategic implementation plan to deliver savings of over a billion pounds", available at: www.cabinetoffice.gov.uk/news/ict-strategy-strategic-implementation-plandeliver-savings-over-billion-pounds (accessed April 18, 2014).

Meer, D.V., Dutta, K. and Datta, A. (2012), "A cost-based database request distribution technique for online E-commerce applications", *Management Information Systems Quarterly*, Vol. 36 No. 2, pp. 479-507.

Mell, P. and Grance, T. (2011), "The NIST definition of cloud computing", available at: http://pre-developer.att.com/home/learn/enablingtechnologies/The_NIST_Definition_of_Cloud_Computing.pdf (accessed August 10, 2014).

Morgan, L. and Conboy, K. (2013), "Factors affecting the adoption of cloud computing: an exploratory study", *Proceedings of the 21st European Conference on Information Systems (ECIS), Utrecht, November 20-25*.

Murguía, M. and Villaseñor, J.L. (2003), "Estimating the effect of the similarity coefficient and the cluster algorithm on biogeographic classifications", *Annales Botanici Fennici*, Vol. 40 No. 6, pp. 415-421.

Myerson, R.B. (1991), *Game Theory: Analysis of Conflict*, Harvard University Press, Cambridge.

National Information Society Agency (NISA) (2008), "Summary on 2007 ASP/SaaS", available at: http://eng.nia.or.kr/english/bbs/board_view.asp?BoardID=20111222161116261 1andid=9288andnowpage=2andOrder=301andsearch_target=andkeyword=andFlag=andobj page=0 (accessed on August 10, 2014).

Neuendorf, K.A. (2002), *The Content Analysis Guidebook*, Sage, Thousand Oaks, CA, p. 10ff.

Nuseibeh, H. (2011), "Adoption of cloud computing in organizations", *Proceedings of the 17th American Conference on Information Systems (AMCIS), Detroit, MI, August 4-8*.

Ocasio, W. (1997), "Towards an attention-based view of the firm", *Strategic Management Journal*, Vol. 18 No. 1, pp. 187-206.

Pereira, J.V. (2009), "The new supply chain's frontier: information management", *International Journal of Information Management*, Vol. 29 No. 5, pp. 372-379.

Pfeffer, J. and Salancik, G.R. (1978), *The External Control of Organizations: A Resource Dependence Perspective*, Harper and Row Publishers, New York, NY, pp. 12-14.

Porter, M.E. (1980), *Competitive Advantage: Creating and Sustaining Superior Performance*, Free Press, New York, NY.

Porter, M.E. and Millar, V.E. (1985), "How information gives you competitive advantage", *Harvard Business Review*, Vol. 63 No. 4, pp. 149-160.

PriceWaterhouseCoopers (2009), "IT-Kosten- und Wertmanagement", available at: www.pwc.de/de/prozessoptimierung/assets/Studie-IT-Kosten-Wertmanagement.pdf (accessed July 10, 2014).

PriceWaterhouseCoopers (2011), "Zuverlässig, Zukuftsorientiert, International", available at: www.pwc.de/de/transport-und-logistik/assets/transport_und_logistik.pdf (accessed July 10, 2014).

Provalis Research (2010), "WordStat 6: Content Analysis Module for QDA Miner and SimStat", available at: www.provalisresearch.com/Documents/WordStat6.pdf (accessed March 13, 2014).

Ranganathan, C., Teo, T.S. and Dhaliwal, J. (2011), "Web-enabled supply chain management: key antecedents and performance impacts", *International Journal of Information Management*, Vol. 31 No. 6, pp. 533-545.

Repschlaeger, J., Wind, S., Zarnekow, R. and Turowski, K. (2012), "Selection criteria for software as a service: an explorative analysis of provider requirements", *Proceedings of the 18th American Conference on Information Systems (AMCIS)*, *Seattle, WA*, *August 9-11*.

Robertson, S. (2004), "Understanding inverse document frequency: on theoretical arguments for IDF", *Journal of Documentation*, Vol. 60 No. 5, pp. 503-520.

Rogers, E.M. (2003), *Diffusion of Innovations*, Free Press, New York, NY, pp. 11-12.

Salleh, S., Teoh, S. and Chan, C. (2012), "Cloud enterprise systems: a review of literature and its adoption", *Proceedings of the 16th Pacific Asia Conference on Information Systems (PACIS)*, *Ho Chi Minh City*, *July 9-12*.

Salton, G. and Buckley, C. (1988), "Term-weighting approached in automatic text retrieval", *Information Processing and Management*, Vol. 14 No. 5, pp. 513-523.

Schafersman, S. (1994), "An introduction to science: scientific thinking and the scientific method", available at: www.geo.sunysb.edu/esp/files/scientific-method.html (accessed July 10, 2014).

Schniederjans, D. and Özpolat, K. (2013), "An empirical examination of cloud computing in humanitarian logistics", available at: www.cba.uri.edu/research/brownbag/spring2013/documents/DaraS2013329paper.pdf (accessed April 29, 2014).

Schrödl, H. (2012), "Purchasing cloud-based product-service bundles in value networks – the role of manageable workloads", *Proceedings of the 20th European Conference on Information Systems (ECIS)*, *Barcelona*, *June 10-13*.

Seethamraju, R. (2013), "Determinants of SaaS ERP systems adoption", *Proceedings of the 17th Pacific Asia Conference on Information Systems (PACIS)*, *Jeju Island*, *June 18-22*.

Sidorova, A., Evangelopoulos, N., Valacich, J.S. and Ramakrishnan, T. (2008), "Uncovering the intellectual core of the information systems discipline", *Management Information Systems Quarterly*, Vol. 32 No. 3, pp. 467-482.

Steinfield, C., Markus, M.L. and Wigand, R.T. (2011), "Through a glass clearly: standards, architecture, and process transparency in global supply chains", *Journal of Management Information Systems*, Vol. 28 No. 2, pp. 75-108.

Sullivan, D. (2001), *Document Warehousing and Text Mining*, Wiley Computer Publishing, New York, NY.

Swafford, P., Ghosh, S. and Murthy, N. (2006), "The antecedents of supply chain agility of a firm: scale development and model testing", *Journal of Operations Management*, Vol. 24 No. 2, pp. 170-188.

Swafford, P.M., Ghosh, S. and Murthy, N. (2008), "Achieving supply chain agility through IT integration and flexibility", *International Journal of Production Economics*, Vol. 116 No. 2, pp. 288-297.

Tan, P.N., Steinbach, M. and Kumar, V. (2005), *Introduction to Data Mining*, Addison-Wesley, Boston, MA.

Tapscott, D., Ticoll, D. and Lowy, A. (2000), *Digital Capital: Harnessing the Power of Business Webs*, Harvard Business Press, Boston, MA.

Tarzey, B. (2012), "Adapting to new data rules", *Computer Weekly*, Vol. 12.

Trist, E. and Bamforth, K. (1951), "Some social and psychological consequences of the longwall method of coal getting", *Human Relations*, Vol. 4 No. 3, pp. 3-38.

Venters, W. and Whitley, E.A. (2012), "A critical review of cloud computing: researching desires and realities", *Journal of Information Technology*, Vol. 27 No. 3, pp. 179-197.

Wagner, S.M. (2008), "Innovation management in the German transportation industry", *Journal of Business Logistics*, Vol. 29 No. 2, pp. 215-231.

Wang, F.Y. (2010), "Parallel control and management for intelligent transportation systems: concepts, architectures, and applications", *Intelligent Transportation Systems*, Vol. 11 No. 3, pp. 630-638.

Wilde, T. and Hess, T. (2007), "Forschungsmethoden der Wirtschaftsinformatik: EINE empirische Untersuchung", *Wirtschaftsinformatik*, Vol. 49 No. 4, pp. 280-287.

Williamson, O. (1981), "The economics of organization: the transaction cost approach", *American Journal of Sociology*, Vol. 87 No. 3, pp. 548-577.

Wind, S., Repschlaeger, J. and Zarnekow, R. (2012), "Towards a cloud computing selection and evaluation environment for very large business applications", *Proceedings of the 18th American Conference on Information Systems (AMCIS)*, *Seattle, WA*, *August 9-11*.

Wu, Y., Cegielski, C.G., Hazen, B.T. and Hall, D.J. (2013), "Cloud computing in support of supply chain information system infrastructure: understanding when to go to the cloud", *Journal of Supply Chain Management*, Vol. 49 No. 3, pp. 25-41.

Xiao, J., Wang, H., Cheng, Z.L., Xie, K. and Hu, Q. (2011), "Why is web-based supply chain management popular in China? A factor endowment's perspective", *Proceedings of the 32nd International Conference on Information Systems (ICIS)*, *Shanghai*, *December 4-7*.

Yan, G., Wen, D., Olariu, S. and Weigle, M.C. (2013), "Security challenges in vehicular cloud computing", *Intelligent Transportation Systems*, Vol. 14 No. 1, pp. 284-294.

Youseff, L., Butrico, M. and Da Silva, D. (2008), "Toward a unified ontology of cloud computing", Grid Computing Environments Workshop 2008 (GCE), Austin, TX, November 16.

Yuhanna, N., Gilpin, M. and Knoll, A. (2010), "The Forrester Wave: information-as-a-service", available at: www.forrester.com/rb/Research/wave%26trade%3B_information-as-aservice%2C_q1_2010/q/id/55 204/t/2 (accessed June 17, 2014).

Zandi, F., Tavana, M. and Martin, D. (2013), "A fuzzy group Electre method for electronic supply chain management framework selection", *International Journal of Logistics: Research and Applications*, Vol. 14 No. 1, pp. 35-60.

Ziekow, H., Fabian, B., Müller, C. and Günther, O. (2010), "RFID in the cloud: a service for high-speed data access in distributed value chains", *Proceedings of the 16th American Conference on Information Systems (AMCIS)*, *Lima*, *August 12-15*.

Further reading

Webster, J. and Watson, R.T. (2002), "Analyzing the past to prepare for the future: writing a literature review", *Management Information Systems Quarterly*, Vol. 26 No. 2, pp. xiii-xxiii.

Appendix

All additional figures and tables to this paper are available online and contain additional information:

Figure 1. 2D interrelations map of cloud computing and supply chain management
Figure 2. Heat map
Table I. Applied five-stage procedure of the systematic literature review
Table II. Selected journals and conferences

Table III. Used keywords during the paper search phase
Table IV. Ranking by absolute word frequency
Table V. Ranking by TF IDF
The figures and tables may be downloaded from: http://tinyurl.com/kx7xzv2

About the authors

Andreas Jede, since 2013, has been a Research Assistant at the Research Group in Accounting and Information Systems, which is part of the Institute of Information Management and Corporate Governance at the University of Osnabrueck. Since 2009 he holds a Master of Business Administration from the University of Osnabrueck and has gained five years of practical experience at managerial accounting and supply chain management within the automotive industry. Andreas Jede is the corresponding author and can be contacted at: andreas-jede@gmx.de

Professor Frank Teuteberg, since 2007, has been Head of the Research Group in Accounting and Information Systems, which is part of the Institute of Information Management and Corporate Governance at the University of Osnabrueck. From 1996 to 2001 he worked as a Research Assistant to Professor. Dr Karl Kurbel (holder of the Chair in Information Systems) at the Europa-Universität Frankfurt (Oder), where he took up a postdoctoral position after his doctoral graduation in May 2001. From April 2004 to October 2007 Frank Teuteberg held a Junior Professorship of E-Business and Information Systems at the University of Osnabrueck. Frank Teuteberg is a Member of the German Logistics Association. He teaches at the Virtual Global University (www.vg-u.de) and is a Regular Visiting Professor at the ESCEM (www.escem.fr) in Tours/Poitiers (France).