Competence in supply chain management: a systematic review

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Abstract

Purpose – This paper aims to present an integrated view of the literature published on all aspects and facets of competence in supply chain management (SCM) and furthermore provides a framework for classifying and analyzing literature to facilitate further study, practice and research.

Design/methodology/approach – A systematic literature review identified 98 peer-reviewed scientific journal publications on the subject of competence in SCM.

Findings – This review identifies and classifies the key content of the subject based on whose competence (level of analysis) and the type of competence (competence element), resulting in a framework that brings together aspects at the individual and organizational level, and of the functional, relational, managerial and behavioral elements of competence from the SCM literature. It furthermore displays the timeliness and wide-ranging character of the subject, as presented by the evolutionary timeline and the main research streams.

Research limitations/implications – Although competence in SCM is a key to business success, the subject is ambiguous and an explicit need exists for more research. This paper provides a foundation for future examination of and theory building in this subject. It also alerts researchers to complementary studies outside of their own "customary" domains.

Practical implications – This paper can support managers in their pursuit to secure competence in SCM and thereby improve outcomes on both individual and organizational level. It can furthermore assist in the development of relevant programs and training sessions.

Originality/value – To the best of authors' knowledge, this work represents the first systematic literature review on the subject of competence in SCM. In addition, it proposes a taxonomy for mapping and evaluating research on this subject.

Keywords Competences, Organizational behaviour, Supply-chain management, Systematic literature review, SCM competency

Paper type Literature review

1. Introduction

Competence is often portrayed as a combination of components, such as knowledge, skills, abilities, capabilities and resources (Athey and Orth, 1999; Prahalad and Hamel, 1990; Sanchez, 2004; Teece *et al.*, 1997). In supply chain management (SCM), competence is a key factor in achieving superior performance and competitiveness. Bowersox *et al.* (2000) conclude that supply chain competency leads to business improvements both operationally and financially. Moreover, the top 25 companies identified as having excellent competence in SCM in the annual research reports by AMR Research/Gartner (Gartner, 2007/2010) obtained substantially higher financial performance than their competitors (Aquino and Draper, 2008; Ellinger *et al.*, 2011; Ellinger *et al.*, 2012).

Although a consensus exists on the importance of competence in SCM for successful business performance, scholars vary considerably regarding the scope and meaning of the subject. In the SCM literature, competence is embraced from a variety of views, and its content remains relatively incoherent. For example, Bagchi (2001) defines supply chain competence as an outcome of physical, institutional and technology diffusion factors, whereas Ngai *et al.* (2011) refer to competence as a "framework for technological, production, and management expertise supporting supply chain capabilities". Others view competence from a strict profession's point of view, debating the vast assortment of competence that supply chain managers need (Christopher, 2012; Cottrill, 2010; McCarter *et al.*, 2005; Myers *et al.*, 2004; Van Hoek *et al.*, 2002). From an educational standpoint, stakeholders (i.e. faculty, students and practitioners) have voiced a considerable range of views on the meaning and importance of competences in SCM (Sauber *et al.*, 2008). Scholars also point out a shift in modern supply chains toward a more relation-based strategy (Shub and Stonebraker, 2009), which has led to calls for more research on additional aspects of competence in SCM, such as the connection between human resource management (HRM) and SCM (Ellinger and

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Ellinger, 2014; Hohenstein *et al.*, 2014; Shub and Stonebraker, 2009). Based on the incoherent view of competence in SCM, and the explicit need and call for more research, we conclude that the subject itself needs to be explored further. We therefore contend that, to achieve a coherent view of competence in SCM, a systematic review of the relevant literature is needed. To the best of our knowledge, no such review yet exists.

The purpose of the present paper, therefore, is to present an integrated view of the literature published on all aspects and facets of competence in SCM and to provide a framework for classifying and analyzing literature to facilitate further study, practice and research. We examine the field of competence in SCM not so much to advance theory but to propose a taxonomy for mapping and evaluating research on competence in SCM. The focus is thus to identify what constitutes competence in SCM. The research questions are the following:

RQ1. How can literature on competence in SCM be classified?

RQ2. What aspects and facets of competence in SCM have been addressed in the field?

The following section details how the systematic literature review was conducted. This is followed by a description of the landscape of competence in SCM, including research streams, an evolutionary timeline and the methodologies used. In Section 4, a two-dimensional framework is presented that addresses the aspects and facets of competence in SCM that are found in the literature. This is followed by a discussion and implications for further research. Finally, the conclusion summarizes the main results of this work.

2. Methodology

This paper presents a systematic literature review following the three-stage approach outlined by Tranfield *et al.* (2003). The approach was previously used in other rigorous SCM reviews, such as that by Delbufalo (2012) and Kamal and Irani (2014). The first stages are presented in the following two subsections, and the last stage is presented in Sections 3 and 4.

2.1 Planning the review

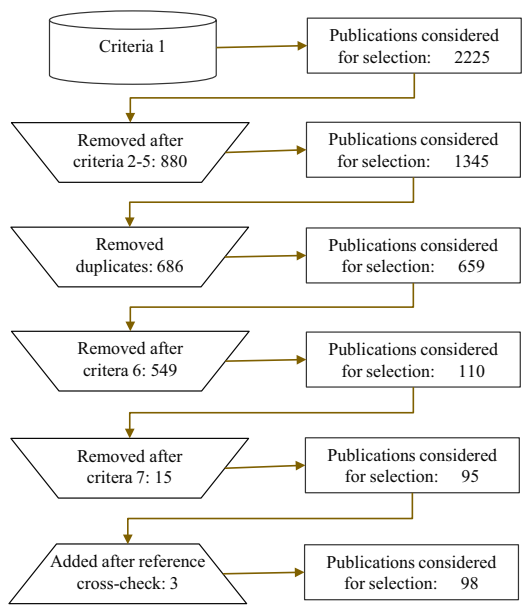
A research protocol was developed in line with the research aim and objectives presented in the introduction. Consistent with the broad scope of the review, we recognize competence in SCM as any personal and organizational attribute that supports the "ability of supply chains to respond to customer demands with low cost, high-quality products and services" (Bowersox *et al.*, 2000). From this perspective, competence is thus considered not only in terms of the final outcome but also in terms of the process leading to that outcome. Regarding the boundaries of the supply chain, we conclude that, despite existing well-used multi-tier supply chain definitions such that of Lambert and Cooper (2000), several scholars have identified a lack of true multitier supply chain use in research (Kembro *et al.*, 2014; Tachizawa and Wong, 2014). Therefore, in the present review, we include not only publications with a multitier perspective but also those with a dual (upstream or downstream) or focal-firm perspective. Considering the above objectives and conceptual framing, a list of criteria was established to select and evaluate which publications to include. These criteria read as follows:

- The EBSCO, Science Direct, Scopus and Web of Science databases were used in the literature search to capture as many publications as possible from as many research disciplines as possible (e.g. management, economy, engineering, sociology and psychology).
- To enhance quality control as suggested by David and Han (2004), only published peer-reviewed scientific journal publications were considered. Thus, books, book sections, conference proceedings and trade journals were excluded.
- No time restrictions were applied.
- Only publications in English were considered.
- Both empirical and conceptual publications were considered to capture the full range of competence in SCM.
- The initial subject screening was based on "competence in SCM" as the key subject term throughout the selection process, including title, abstract and keywords. Thereafter, this same subject term was used for the entire selected paper.
- The final screening for substantive relevance consisted of reading the remaining publications in their entirety. This aligned the selected publications with the scope of this literature review, with the goal being to capture the core of competence in SCM.

2.2 Conducting the review

The seven criteria presented above were strictly applied to ensure an effective and reproducible database search (Fink, 2014; Booth *et al.*, 2012) and to avoid personal preferences and selectivity (Bennett *et al.*, 2005). The retrieval process is presented in Figure 1 and starts by entering the search terms in the fields "title", "abstract" and "keywords". The search terms were modified to "competenc*", "supply chain" and "manage*" to cover variants such as "competency" and "managerial". Each search term was entered as a single string joined by the AND operator to maximize the target range of management in supply chains and thereby include not only

Figure 1 Flowchart of publication-retrieval process



SCM but also, for example, supply chain risk management, supply chain performance and knowledge management. This process yielded 2,225 publications. After application of criteria 2-5, 880 publications were excluded, leaving 1,345 publications. After removing duplicates, 659 publications remained for further investigation. All 659 publications were screened for substantive content following Criterion 6, leaving 110 publications. The next step was to read the publications in their entirety (Criteria 7) and ensure that they were aligned with the core of competence in SCM; this process yielded 95 publications. In addition, we cross-checked all selected publications (Booth *et al.*, 2012), adding references from all publications retrieved that met the inclusion Criteria 2-7 above. This added three more publications, which indicates that the bulk of the literature on the subject was found in the first round of searching. The publications were retrieved in April 2016, and the 98 publications retrieved were considered sufficient to present an adequate overview of the field.

Inspired by content analysis (Stemler, 2001; Seuring and Gold, 2012), we categorized and structured the selected publications by using an analytical scheme (matrix). For the descriptive analysis, the following information was provided for each publication: author(s), year, journal, industry and methodology. For the thematic analysis, an interpretative synthesis was applied based on the core content of the publications and the questions driving their research. Cross-study concepts were identified and iteratively translated into categories inspired by existing frameworks in the literature. The advantage of this method is its ability to synthesize multiple qualitative studies, whereas the challenge is to strengthen replicability because the coding relies on the researcher(s) (Rousseau *et al.*, 2008). We held cross-coding meetings to discuss potential discrepancies. Disagreements were resolved by discussions leading to interactions that led to consensus. A pivotal summary helped to analyze and interpret the data.

3. The literature landscape

The review found the literature on competence in SCM to be fragmented and diversified. The 98 selected publications were published in 51 unique research journals (see Appendix 1), with only eight research journals publishing more than two publications. The same fragmented pattern appears for authors: The total number was 229 but only 25 contributed to more than one publication (Appendix 2). The following sections present the research streams found in the literature, an evolutionary timeline for the publications and the methodologies used.

3.1 Research streams

The publications covered a wide range of areas that fall under the complexity of supply chains. To present the selected literature in a structured way, we derived and consolidated a number of research streams based on previously published systematic literature reviews on SCM. Croom *et al.* (2000) and Burgess *et al.* (2006) present comprehensively their content-oriented findings on the components of SCM literature, whereas Hohenstein *et al.* (2014) identify research streams in literature on HRM in SCM. An iterative matching of the selected literature resulted in the following research streams: business results and outcomes; strategic management; process improvement orientation; logistics; education and training; organizational behavior; and, finally, relationships. Although disagreement exists regarding overlap and interaction between the research streams, the features of the selected publications are sufficiently distinctive to be treated as single themes, so they appear in the research stream that best fits their topic (Table I).

Selected publications in the research stream *business results and outcomes* focus on financial performance and other customer-related outcomes based on an excellent level of competence. The research stream *strategic management* includes publications with a focus on competence for higher-level decisions, such as strategic sourcing and the protection of core competences. Publications in the research stream *process improvement orientation* focus on competence in processual arrangements, such as lean and just-in-time that facilitate operations, agility, and interactions within and between organizations. The research stream *logistics* includes publications that focus on competence to achieve logistics service quality and emerging issues such as fourth party logistics (4PL) and reverse logistics. The research stream *education and training* includes publications that cover competence development in both academia and industry. Publications in the research stream *organizational behavior* focus on HRM, organizational learning and employee-competence profiles. Finally, the research stream *relationships* includes publications focusing on collaborative competences and the nature of relationships between stakeholders from different departments and organizations.

3.2 Evolutionary timeline of literature

The review found that competence in SCM is a new and emerging area that is garnering increasing interest from researchers. Figure 2 presents the evolutionary timeline, showing that competence in SCM began to gain academic attention in the beginning of this millennium and is continuously growing. The publication rate was quite low the first six years (2000-2005), with 1-5 publications per year. In the following years (2006-2014), the publication rate increased to 5-12 publications per year. An explanation for this interest in the past decade may be that SCM has matured, both in research and in practice, thereby highlighting the need for competence in SCM.

3.3 Methodologies used

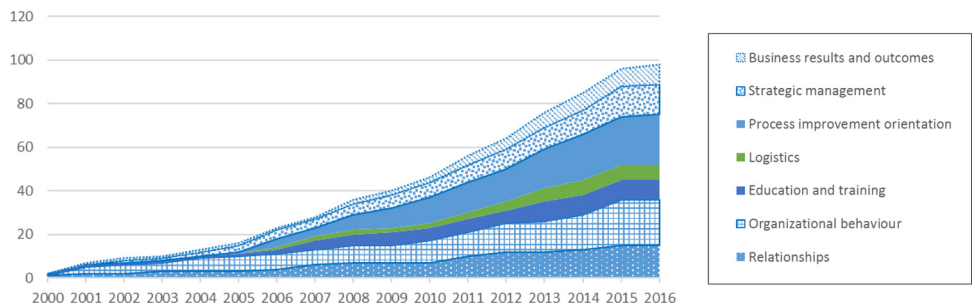
The review demonstrates that competence literature in SCM embraces a diversity of methodological approaches. As can be seen in Table II, both qualitative and quantitative approaches have been used as well as a combination of these approaches, along with conceptual papers. This variety indicates a broad examination and coverage of the research subject. However, the unbalanced distribution of publications among the methodologies used suggests a limited perspective on the phenomena under investigation. This is in line with the narrow methodology focus that has been criticized by several SCM scholars (Mangan *et al.*, 2004; Näslund, 2002; Golicic and Davis, 2012).

A majority of the selected publications have a quantitative research approach. Of these, the statistical sampling method

Table I Research streams that appear in literature reviewed

Research stream	Publication references	Count
Business results and outcomes	Blome *et al.* (2013), Bowersox *et al.* (2000), Chiadamrong and Suppakitjarak (2008), Ellinger *et al.* (2011, 2012), Essex *et al.* (2016), Golini *et al.* (2014), Hsu *et al.* (2011), Ling-Yee and Ogunmokun (2001), Shukla *et al.* (2013)	10
Strategic management	Ambulkar *et al.* (2016), Armoutis *et al.* (2008), Berlak and Weber (2004), Chikán and Gelei (2010), Drejer and Sørensen (2002), Ellinger *et al.* (2015), Feldmann and Olhager (2013), Kusaba *et al.* (2011), Lin *et al.* (2016), Lutz and Ritter (2009), Mollenkopf and Dapiran (2005), Parry *et al.* (2010), Perunović *et al.* (2012), Wang *et al.* (2008)	14
Process improvement orientation	Barclay (2005), Das and Narasimhan (2000), Davis and Golicic (2010), Ferrer *et al.* (2011), George and Rangaraj (2006), Green *et al.* (2014), Halley and Beaulieu (2001), Halley and Beaulieu (2009), Jüttner *et al.* (2006), Malekifar *et al.* (2014), Marcus and Anderson (2006), Morgan *et al.* (2016), Ngai *et al.* (2011), Parry *et al.* (2006), Roth *et al.* (2008), Salvador and Villena (2013), Samuel and Spalanzani (2009), Sangari. and Razmi (2015), Schoenherr *et al.* (2014), Schoenherr and Narasimhan (2012), Sun (2013), Varella. and Gonçalves (2013), Venkatasubramanian and Baskaran (2014), Wieland and Wallenburg (2013)	24
Logistics	Ding *et al.* (2015), Fulconis *et al.* (2006), Jasemi *et al.* (2014), Richey *et al.* (2007), Rogers *et al.* (2013), Tokman *et al.* (2011), Wadhwa *et al.* (2008)	7
Education and training	Bernon and Mena (2013), Bölsche *et al.* (2013), Margherita *et al.* (2009), Okongwu (2007), Pyne *et al.* (2007), Sauber *et al.* (2008), Sohal (2013), Stentoft Arlbjørn *et al.* (2006)	8
Organizational behavior	Ding *et al.* (2012), Dotson *et al.* (2015), Dubey and Gunasekaran (2015), Ellinger and Ellinger, A. D. (2014), Gammelgaard and Larson (2001), Halley *et al.* (2006), Harvey and Richey (2001), Heide *et al.* (2008), Huo *et al.* (2015), Kayakutlu and Büyüközkan (2010), Kovács *et al.* (2011), Mangan and Christopher (2005), Myers *et al.* (2004), Prajogo and Sohal (2013), Richey *et al.* (2010), Richey and Wheeler (2004), Shou and Wang (2015), Spekman *et al.* (2002), Thai (2012a,b), Thai and Yeo (2015)	21
Relationships	Barnes and Liao (2012), Cox (2001), Ha *et al.* (2011), Halley *et al.* (2010), Hanna (2007), Kern *et al.* (2011), Kim and Wemmerloev (2015), Møller *et al.* (2003), Paulraj *et al.* (2008), Rosenzweig and Roth (2007), Stuart, 2012, Torkkeli (2014), Whipple *et al.* (2015), Zacharia (2011)	14
Total		98

Figure 2 Evolutionary timeline of literature reviewed (accumulated)



dominates; it uses surveys (primary data) and databases (secondary data), although with somewhat different purposes. Fourteen publications use sampling primarily to map and measure the importance of various competences, while another eight publications use it to compare the relationship between aspects such as flexibility, customer service and financial results to different levels of operational competence. Statistical sampling is also used to test hypothesis models. These models include variables such as operational routines, integration, logistics service quality and organizational performance.

Approximately one of five of the selected publications have a qualitative research approach. The ten case studies provide an in-depth understanding of cooperation and competence development in a variety of contexts, and of the challenge of protecting core competences. The majority has a single case design, and the data were collected from interviews, site visits and focus groups. The seven publications using case-based testing use case(s) to validate proposed instruments or hypotheses. One publication uses experts in a Delphi-based approach to develop a competence model for effective supply value chain management (Kayakutlu and Büyüközkan, 2010).

Fourteen of the selected publications are conceptual and offer insights into a number of areas ranging from human behavior to business processes. Only three publications (Gammelgaard and Larson, 2001; Ferrer *et al.*, 2011; Mangan and Christopher, 2005) use a multi-methodology approach, applying a combination of survey and case-study research. Literature reviews are notable in their absence.

4. Framework

The main challenge in setting up a framework is to address the many different aspects and facets of competence in SCM

Table II Methodologies used in literature reviewed

Methodology	Publication references	Count
Quantitative		63
Numerical	Jasemi *et al.* (2014), Varella. and Gonçalves (2013)	2
Statistical sampling–mapping	Bölsche *et al.* (2013), Dotson *et al.* (2015), Dubey and Gunasekaran (2015), George and Rangaraj (2006), Heide *et al.* (2008), Kovács *et al.* (2011), Okongwu (2007), Prajogo and Sohal (2013), Shou and Wang (2015), Shukla *et al.* (2013), Sohal (2013), Thai (2012a,b), Thai and Yeo (2015)	14
Statistical sampling–comparison	Bowersox *et al.* (2000), Chikán and Gelei (2010), Ellinger *et al.* (2011, 2012), Halley and Beaulieu (2009), Halley *et al.* (2010), Mollenkopf and Dapiran (2005), Pyne *et al.* (2007)	8
Statistical sampling–hypothesis testing	Ambulkar *et al.* (2016), Barnes and Liao (2012), Blome *et al.* (2013), Chiadamrong and Suppakitjarak (2008), Das and Narasimhan (2000), Davis and Golicic (2010), Ding *et al.* (2012), Ding *et al.* (2015), Ellinger *et al.* (2015), Essex *et al.* (2016), Feldmann and Olhager (2013), Golini *et al.* (2014), Green *et al.* (2014), Ha *et al.* (2011), Hsu *et al.* (2011), Huo *et al.* (2015), Kern *et al.* (2011), Kim and Wemmerloev (2015), Kusaba *et al.* (2011), Ling-Yee and Ogunmokun (2001), Marcus and Anderson (2006), Morgan *et al.* (2016), Myers *et al.* (2004), Paulraj *et al.* (2008), Richey *et al.* (2007), Rosenzweig and Roth (2007), Roth *et al.* (2008), Salvador and Villena (2013), Sangari. and Razmi (2015), Schoenherr *et al.* (2014), Schoenherr and Narasimhan (2012), Spekman *et al.* (2002), Stentoft Arlbjørn *et al.* (2006), Stuart, 2012, Sun (2013), Torkkeli (2014), Whipple *et al.* (2015), Wieland and Wallenburg (2013), Zacharia (2011)	39
Qualitative		18
Case study	Berlak and Weber (2004), Bernon and Mena (2013), Fulconis *et al.* (2006), Hanna (2007), Lutz and Ritter (2009), Parry *et al.* (2006), Parry *et al.* (2010), Samuel and Spalanzani (2009), Sauber *et al.* (2008), Wadhwa *et al.* (2008)	10
Case-based testing	Armoutis *et al.* (2008), Barclay (2005), Jüttner *et al.* (2006), Lin *et al.* (2016), Møller *et al.* (2003), Ngai *et al.* (2011), Perunović *et al.* (2012)	7
Delphi-based	Kayakutlu and Büyüközkan (2010)	1
Conceptual	Cox (2001), Drejer and Sørensen (2002), Ellinger and Ellinger (2014), Halley and Beaulieu (2001), Halley *et al.* (2006), Harvey and Richey (2001), Malekifar *et al.* (2014), Margherita *et al.* (2009), Richey *et al.* (2010), Richey and Wheeler (2004), Rogers *et al.* (2013), Tokman *et al.* (2011), Wang *et al.* (2008), Venkatasubramanian and Baskaran (2014)	14
Multi-methodology	Ferrer *et al.* (2011), Gammelgaard and Larson (2001), Mangan and Christopher (2005)	3
Total		98

found in the literature. We contend that a two-dimensional approach to literature content analysis allows us to address both the level of analysis and the elements of competence, and to create a foundation for further discussions about the interaction between the two.

4.1 Dimension one – level of analysis

The literature reviewed herein addresses the competence of several stakeholders. To understand which stakeholder(s) the literature addresses, the publications are classified according to the level of analysis, referring to on *whose* competence the literature focuses. We identified three levels, although not all are equally present in the literature:

1 *individual level*: considers competences related to individuals;
2 *intra-organizational level*: relates to competence in and between different functions of an organization; and
3 *inter-organizational level*: relates to competence between organizations.

A diverse group of stakeholders appears in each level of analysis. This was expected because of the emerging and encompassing area of competence in SCM. As shown in Table III, the individual level is considered in approximately one-third of the publications, with almost one-third of these focusing on other-than-supply-chain professionals. More than half of the publications treat the intra-organizational level, dealing with a variety of organizations and departments. The inter-organizational level is covered in approximately one-fifth of the publications, of which more than a third are related to the manufacturing industry. A few stakeholders appear to exist on both the intra- and inter-organizational level; for example, small and medium sized enterprises (SMEs) and logistics service providers (LSPs). However, on the intra-organizational level, the competence studied is attached to a department or a company, whereas in the latter case it is attached to the network between multiple companies. Note also the limited overlap in the literature between the levels, which indicates that most publications discuss a single level of analysis. This is consistent with the findings of Croom *et al.* (2000) in their critical review of SCM literature, where they point out the limited links in

Table III Levels of analysis in literature reviewed

Level of analysis	Publication references	Count
Individual		29
Supply chain professionals	Ambulkar *et al.* (2016), Barnes and Liao (2012), Dotson *et al.* (2015), Dubey and Gunasekaran (2015), Ellinger and Ellinger (2014), Essex *et al.* (2016), Gammelgaard and Larson (2001), Harvey and Richey (2001), Kovács *et al.* (2011), Mangan and Christopher (2005), Myers *et al.* (2004), Okongwu (2007), Prajogo and Sohal (2013), Richey *et al.* (2010), Richey and Wheeler (2004), Shou and Wang (2015), Sohal (2013), Thai and Yeo (2015)	18
Logistics employees	Thai (2012a,b)	2
Professionals	Kusaba *et al.* (2011)	1
Agribusiness managers	Margherita *et al.* (2009)	1
Humanitarian logisticians	Bölsche *et al.* (2013)	1
Students	Bernon and Mena (2013), Pyne *et al.* (2007), Sauber *et al.* (2008)	3
Employees in general	Kayakutlu and Büyüközkan (2010), Rosenzweig and Roth (2007), Stentoft Arlbjørn *et al.* (2006)	3
Intra-organizational		56
HR department	Ellinger and Ellinger (2014)	1
Purchasing department	Cox (2001), Das and Narasimhan (2000), Halley *et al.* (2010), Kusaba *et al.* (2011), Parry *et al.* (2010)	5
Seller/market department	Rosenzweig and Roth (2007)	1
Retail companies	Marcus and Anderson (2006)	1
Manufacturing companies	Barnes and Liao (2012), Blome *et al.* (2013), Chikán and Gelei (2010), Ellinger *et al.* (2015), Feldmann and Olhager (2013), George and Rangaraj (2006), Golini *et al.* (2014), Green *et al.* (2014), Halley and Beaulieu (2009), Huo *et al.* (2015), Jüttner *et al.* (2006), Kim and Wemmerloev (2015), Lin *et al.* (2016), Ling-Yee and Ogunmokun (2001), Parry *et al.* (2006), Roth *et al.* (2008), Salvador and Villena (2013), Sangari. and Razmi (2015), Schoenherr and Narasimhan (2012), Shukla *et al.* (2013), Sun (2013), Wieland and Wallenburg (2013)	22
Contracted manufacturer	Lutz and Ritter (2009), Perunović *et al.* (2012)	2
LSP	Davis and Golicic (2010), Ding *et al.* (2012), Ding *et al.* (2015), Wadhwa *et al.* (2008)	4
SME	Barclay (2005), Hsu *et al.* (2011), Malekifar *et al.* (2014), Schoenherr *et al.* (2014), Torkkeli (2014)	5
Companies in general	Bowersox *et al.* (2000), Chiadamrong and Suppakitjarak (2008), Drejer and Sørensen (2002), Ellinger *et al.* (2011, 2012), Heide *et al.* (2008), Kayakutlu and Büyüközkan (2010), Kern *et al.* (2011), Mollenkopf and Dapiran (2005), Morgan *et al.* (2016), Ngai *et al.* (2011), Rogers *et al.* (2013), Tokman *et al.* (2011), Wang *et al.* (2008), Zacharia (2011)	15
Inter-organizational		23
Manufacturing industry	Barnes and Liao (2012), Hanna (2007), Kim and Wemmerloev (2015), Paulraj *et al.* (2008), Rosenzweig and Roth (2007), Whipple *et al.* (2015)	6
Manufacturing vs retail industry	Richey *et al.* (2007)	1
LSP	Ferrer *et al.* (2011), Fulconis *et al.* (2006)	2
SME	Armoutis *et al.* (2008), Berlak and Weber (2004)	2
Retail industry	Jasemi *et al.* (2014), Møller *et al.* (2003)	2
Pharma industry	Samuel and Spalanzani (2009)	1
General industry	Ha *et al.* (2011), Halley and Beaulieu (2001), Halley *et al.* (2006), Morgan *et al.* (2016), Ngai *et al.* (2011), Spekman *et al.* (2002), Stuart, 2012, Varella. and Gonçalves s(2013), Venkatasubramanian and Baskaran (2014)	9
Total		108[a]

Note: [a] Although 98 publications were reviewed, eight publications involved more than one level of analysis and were thus placed in multiple categories

research between competence on individual, organizational, and supply chain level.

4.2 Dimension two – elements of competence

The second dimension refers to the *type* of competence on which the literature focuses, where existing literature supports the conceptualization of competence in SCM as a multidimensional construct. The classic supply chain competency framework by Bowersox *et al.* (2000) includes three contexts: operational, behavioral and planning and control. In parallel, Sangari and Razmi (2015) propose classification according to managerial, technical and cultural competences in SCM. Other researchers choose a two-dimensional approach, such as Tokman *et al.* (2011) and

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Zacharia *et al.* (2011), both of whom look at operational and relational dimensions of outcomes in their research on supply chains. Inspired by the research above, we derived an extended version with four elements of competence. These were considered adequate to cover the wide range of competences included in the selected publications, and, although an argument may be made that overlap and interconnections exist between the elements, the features of the latter are sufficiently distinctive to be treated as individual elements. Note that competence in SCM is not defined by any element in isolation but rather by a combination of elements.

The elements are described as follows:

- *Functional competence* deals with competence directly related to existing SCM business functions and company processes, such as sourcing, manufacturing and distribution. Functional competence can be studied on the operational, tactic and strategic level.
- *Relational competence* deals with relational competences between all possible stakeholders, such as employees, customers, suppliers, partners, managers and departments.
- *Managerial competence* includes all competences related to more general management aspects of competence in SCM, such as implementation of new structures or business segments, control and evaluation, resource management (people and cost) and overall strategy development.
- *Behavioral competence* relates to built-in or developed attitudes and characteristics tied to the stakeholder, such as creativity or change orientation. Table IV shows how the elements are distributed in the publications.

In contrast to the level of analysis, the average number of elements per publication is close to 2.5, which means that the literature reviewed encompasses several elements when discussing competence in SCM. However, while merely one of five publications includes all four elements, half of the publications cover only one or two elements. This strengthens the view of competence in SCM as being a complex and encompassing area on which no consensus exists within the research community.

4.3 Two-dimensional content analysis

To present an integrated view of the literature, with a focus on competence itself, the three levels of analysis and the four elements of competence are combined in a matrix (Table V). Based on the content contained in the framework, the subsections that follow offer insights into the aspects and facets found in the literature reviewed.

4.3.1 Functional competence in supply chain management

Being the core of SCM, functional competence is the most-studied element in this review, and the literature reviewed also covers competence in relation to most of the functions and processes embraced under the SCM umbrella. On the *individual* level, the literature deals with aspects of logistics procedures, ranging from customs procedures to multimodal transports and reverse logistics (Thai and Yeo, 2015), and sales and operations planning procedures, covering everything from supply to production and demand management (Sauber *et al.*, 2008; Shou and Wang, 2017). The literature further includes aspects on techniques and technology knowledge (Gammelgaard and Larson, 2001), including computer literacy (Okongwu, 2007) and ability to process data (Shou and Wang, 2017).

At the *intra-organizational* level, nine of ten publications include the functional competence element, and the literature reviewed deals with a wide range of aspects. Literature on supply management aspects discuss how to deal with supply and supplier management (Kern *et al.*, 2011), including how to use the power relation between buyer and seller (Cox, 2001). Production-management literature deals first not only with efficiency and flexibility aspects (Ngai *et al.*, 2011; Schoenherr and Narasimhan, 2012) but also with process development to increase process stability, reduce variances and thereby increase quality (Kim and Wemmerloev, 2015). Literature on logistics management deals with competence relating to capacity issues and the range of logistical offers (Ding *et al.*, 2012), along with inventory management (Jasemi *et al.*, 2014). It also deals with competence in delivery and returns management, including fast and correct deliveries to customers (Halley and Beaulieu, 2009), and a systematic returns-flow process (Morgan *et al.*, 2016). Demand-management literature includes demand sensing, demand shaping and order fulfilment (Ellinger *et al.*, 2012; Chikán and Gelei, 2010), whereas product-development-management literature deals with competence aspects of the development and introduction of new products, based on understanding the market, the use of feedback from previous projects and knowledge from other supply chain partners (Schoenherr *et al.*, 2014).

Ability in information and communications technology (ICT) is a fundamental organizational attribute and is discussed from three perspectives: ICT functionality, ICT integration and ICT deployment. The literature reviewed on ICT functionality highlights the IT infrastructure and having all the needed systems in place (Davis and Golicic, 2010). ICT integration is not only about providing efficient, timely and transparent business information to appropriate parties but also about including flexibility based on connectivity, compatibility and modularity (Ngai *et al.*, 2011). ICT deployment refers to ICT availability (Sangari and Razmi, 2015), but most of all training and the effective use of ICT (Barclay, 2005). Finally, an aspect of supply chain alignment management competence is present in the literature, dealing with alignment of demand creation and demand fulfilment (Jüttner *et al.*, 2006) and how to achieve process compliance in line with the overall company strategy (Blome *et al.*, 2013).

On the *inter-organizational* level, the literature reviewed highlights logistics service capability, business capability and system connectivity and compatibility. Logistics service capability is discussed both in terms of quality (accuracy) (Richey *et al.*, 2007) and content (infrastructure and range of offers) (Fulconis *et al.*, 2006). Business capability is discussed in terms of collaborative and complementary capabilities in new product development (NPD), manufacturing and forecasting, which leads to flexibility and responsiveness and improved customer satisfaction (Samuel and Spalanzani, 2009). Finally, the literature mentions aspects of system connectivity and compatibility as competence characteristics, which in turn affect supply chain flexibility (Ngai *et al.*, 2011; Ha *et al.*, 2011).

Table IV Elements of competence in literature reviewed

Elements of competence	Publication references	Count
Functional	Armoutis *et al.* (2008), Barclay (2005), Barnes and Liao (2012), Berlak and Weber (2004), Bernon and Mena (2013), Blome *et al.* (2013), Bowersox *et al.* (2000), Bölsche *et al.* (2013), Chiadamrong and Suppakitjarak (2008), Chikán and Gelei (2010), Cox (2001), Das and Narasimhan (2000), Davis and Golicic (2010), Ding *et al.* (2012), Ding *et al.* (2015), Drejer and Sørensen (2002), Dubey and Gunasekaran (2015), Ellinger and Ellinger (2014), Ellinger *et al.* (2011, 2012), Essex *et al.* (2016), Feldmann and Olhager (2013), Ferrer *et al.* (2011), Fulconis *et al.* (2006), Gammelgaard and Larson (2001), George and Rangaraj (2006), Golini *et al.* (2014), Green *et al.* (2014), Ha *et al.* (2011), Halley and Beaulieu (2009), Halley *et al.* (2010), Halley *et al.* (2006), Hanna (2007), Heide *et al.* (2008), Jasemi *et al.* (2014), Jüttner *et al.* (2006), Kern *et al.* (2011), Kim and Wemmerloev (2015), Kusaba *et al.* (2011), Ling-Yee and Ogunmokun (2001), Lutz and Ritter (2009), Malekifar *et al.* (2014), Mangan and Christopher (2005), Marcus and Anderson (2006), Margherita *et al.* (2009), Mollenkopf and Dapiran (2005), Morgan *et al.* (2016), Møller *et al.* (2003), Ngai *et al.* (2011), Okongwu (2007), Parry *et al.* (2010), Paulraj *et al.* (2008), Perunović *et al.* (2012), Richey *et al.* (2007), Rogers *et al.* (2013), Rosenzweig and Roth (2007), Roth *et al.* (2008), Salvador and Villena (2013), Samuel and Spalanzani (2009), Sangari. and Razmi (2015), Sauber *et al.* (2008), Schoenherr *et al.* (2014), Schoenherr and Narasimhan (2012), Shou and Wang (2015), Shukla *et al.* (2013), Sohal (2013), Stuart, 2012, Sun (2013), Thai (2012a,b), Thai and Yeo (2015), Tokman *et al.* (2011), Wadhwa *et al.* (2008), Wang *et al.* (2008), Venkatasubramanian and Baskaran (2014), Wieland and Wallenburg (2013)	76
Relational	Barclay (2005), Barnes and Liao (2012), Bernon and Mena (2013), Bowersox *et al.* (2000), Bölsche *et al.* (2013), Chiadamrong and Suppakitjarak (2008), Das and Narasimhan (2000), Dotson *et al.* (2015), Dubey and Gunasekaran (2015), Ellinger *et al.* (2015), Ellinger and Ellinger (2014), Essex *et al.* (2016), Feldmann and Olhager (2013), Ferrer *et al.* (2011), Gammelgaard and Larson (2001), Ha *et al.* (2011), Halley *et al.* (2010), Halley *et al.* (2006), Hanna (2007), Harvey and Richey (2001), Heide *et al.* (2008), Hsu *et al.* (2011), Huo *et al.* (2015), Kayakutlu and Büyüközkan (2010), Kern *et al.* (2011), Kim and Wemmerloev (2015), Kovács *et al.* (2011), Kusaba *et al.* (2011),Lin *et al.* (2016), Ling-Yee and Ogunmokun (2001), Mangan and Christopher (2005), Margherita *et al.* (2009), Mollenkopf and Dapiran (2005), Morgan *et al.* (2016), Myers *et al.* (2004), Møller *et al.* (2003), Okongwu (2007), Paulraj *et al.* (2008), Perunović *et al.* (2012), Prajogo and Sohal (2013), Pyne *et al.* (2007), Richey *et al.* (2010), Richey and Wheeler (2004), Rosenzweig and Roth (2007), Roth *et al.* (2008), Salvador and Villena (2013), Samuel and Spalanzani (2009), Schoenherr *et al.* (2014), Shou and Wang (2015), Sohal (2013), Spekman *et al.* (2002), Stuart, 2012, Thai (2012a,b), Thai and Yeo (2015), Tokman *et al.* (2011), Torkkeli (2014), Wadhwa *et al.* (2008), Wang *et al.* (2008), Venkatasubramanian and Baskaran (2014), Whipple *et al.* (2015), Wieland and Wallenburg (2013)	62
Managerial	Ambulkar *et al.* (2016), Armoutis *et al.* (2008), Barclay (2005), Bernon and Mena (2013), Bowersox *et al.* (2000), Bölsche *et al.* (2013), Chikán and Gelei (2010), Das and Narasimhan (2000), Davis and Golicic (2010), Dotson *et al.* (2015), Drejer and Sørensen (2002), Dubey and Gunasekaran (2015), Ellinger *et al.* (2015), Ellinger and Ellinger (2014), Ellinger *et al.* (2011, 2012), Ferrer *et al.* (2011), Fulconis *et al.* (2006), Gammelgaard and Larson (2001), Green *et al.* (2014), Ha *et al.* (2011), Halley and Beaulieu (2001), Halley and Beaulieu (2009), Halley *et al.* (2010), Halley *et al.* (2006), Harvey and Richey (2001), Heide *et al.* (2008), Hsu *et al.* (2011), Huo *et al.* (2015), Kayakutlu and Büyüközkan (2010), Kern *et al.* (2011), Kim and Wemmerloev (2015), Kovács *et al.* (2011), Kusaba *et al.* (2011), Mangan and Christopher (2005), Margherita *et al.* (2009), Mollenkopf and Dapiran (2005), Myers *et al.* (2004), Møller *et al.* (2003), Ngai *et al.* (2011), Okongwu (2007), Parry *et al.* (2006), Parry *et al.* (2010), Paulraj *et al.* (2008), Perunović *et al.* (2012), Prajogo and Sohal (2013), Richey *et al.* (2010), Richey and Wheeler (2004), Rosenzweig and Roth (2007), Sangari. and Razmi (2015), Schoenherr *et al.* (2014), Shou and Wang (2015), Shukla *et al.* (2013), Sohal (2013), Spekman *et al.* (2002), Sun (2013), Thai (2012a,b), Thai and Yeo (2015), Tokman *et al.* (2011), Torkkeli (2014), Wadhwa *et al.* (2008), Varella. and Gonçalves (2013), Venkatasubramanian and Baskaran (2014), Whipple *et al.* (2015), Zacharia (2011)	66
Behavioral	Ambulkar *et al.* (2016), Barnes and Liao (2012), Bernon and Mena (2013), Bölsche *et al.* (2013), Chiadamrong and Suppakitjarak (2008), Das and Narasimhan (2000), Dotson *et al.* (2015), Drejer and Sørensen (2002), Dubey and Gunasekaran (2015), Ellinger *et al.* (2015), Ellinger and Ellinger (2014), Ellinger *et al.* (2011), Gammelgaard and Larson (2001), George and Rangaraj (2006), Ha *et al.* (2011), Halley *et al.* (2006), Harvey and Richey (2001), Hsu *et al.* (2011), Kayakutlu and Büyüközkan (2010), Kovács *et al.* (2011), Kusaba *et al.* (2011), Malekifar *et al.* (2014), Myers *et al.* (2004), Møller *et al.* (2003), Ngai *et al.* (2011), Okongwu (2007), Paulraj *et al.* (2008), Prajogo and Sohal (2013), Richey *et al.* (2010), Richey *et al.* (2007), Richey and Wheeler (2004), Rosenzweig and Roth (2007), Roth *et al.* (2008), Sangari. and Razmi (2015), Schoenherr *et al.* (2014), Shou and Wang (2015), Sohal (2013), Spekman *et al.* (2002), Stentoft Arlbjørn *et al.* (2006), Thai (2012a,b), Thai and Yeo (2015), Tokman *et al.* (2011), Venkatasubramanian and Baskaran (2014), Zacharia (2011)	45
Total		249[a]

Note: [a] Although 98 publications were reviewed, many publications involved more than one element of competence and were thus placed in multiple categories

Table V Framework presenting aspects and facets of competence in SCM literature

Element of competence	Individual	Intra-organizational	Inter-organizational
Functional	Logistics procedures Sales and operations planning (S&OP) procedures Technique and technology knowledge	Supply management Production management Logistics service management Demand management Product development management ICT ability Supply chain alignment management	Logistics service capability Business capability System connectivity and compatibility
Relational	Communication Teamwork Cultural and cross-functional awareness	Relationship management Relationship integration	Relational capital Structural capital Cognitive capital
Managerial	Business analysis Business management People management Company and industry experience	Business intelligence Business strategy Resource management Business execution	Information management Business management
Behavioral	Self-management Self-motivation Empathy Leadership Creativity Cognitive skills	Change and learning orientation Collaborative orientation	Cultural orientation

4.3.2 Relational competence in supply chain management

The relational competence element is the glue in SCM that keeps the various stakeholders together. On the *individual* level, the literature reviewed provides three distinct aspects of competence, namely, communication, teamwork and cultural and cross-functional awareness. Communication is the top aspect found in all publications dealing with relational competence on this level [Shou and Wang (2017) and Gammelgaard and Larson (2001)]. Teamwork and teambuilding is another frequently mentioned aspect (Mangan and Christopher, 2005; Dotson *et al.*, 2015), whereas cultural and cross-functional awareness is emerging and is an extension of the previous two aspects (Prajogo and Sohal, 2013; Sohal, 2013).

On the *intra-organizational* level, selected literature on relationship management deals with the management of existing relationships, involving aspects such as value-adding factors (Tokman *et al.*, 2011), conflict management (Rosenzweig and Roth, 2007) and knowledge transfer (Halley *et al.*, 2006). Not surprisingly, several types of relationships are included in the literature, from customer service management (Barclay, 2005) and development of upstream suppliers (Feldmann and Olhager, 2013) to pure buyer and supplier relationships (Kern *et al.*, 2011; Chiadamrong and Suppakitjarak, 2008). The literature on relationship integration focuses on integration of new or existing relationships based on cooperation for mutual gain and involves aspects of both technical collaboration (Ling-Yee and Ogunmokun, 2001) and relational capital (Schoenherr *et al.*, 2014). Bowersox *et al.* (2000) point out the competences needed to succeed with supplier, customer and internal integration, respectively, and they conclude that internal integration is often more difficult than the first two. Nevertheless, integration is proven to be an antecedent to supply chain performance (Bowersox *et al.*, 2000).

The competence characteristics discussed on the *inter-organizational* level can be divided into aspects of relational, structural and cognitive capital. Relational capital is based on trust and a concern or mentality that all parties will consider the welfare of others as well as their own (Stuart *et al.*, 2012; Spekman *et al.*, 2002). Competence literature on structural capital aspects discusses how parties interact and communicate on a real-time basis (Whipple *et al.*, 2015) and to which degree parties share information that will facilitate the other party's activities (Kim and Wemmerloev, 2015). Finally, literature on cognitive capital refers to a collaborative awareness, where the parties have a common purpose and share the same vision (Barnes and Liao, 2012; Whipple *et al.*, 2015).

4.3.3 Managerial competence in supply chain management

The managerial competence element is at the heart of SCM, and the future of supply chains is based on these competences. The *individual* level in the literature reviewed on managerial competence includes aspects of business analysis, business management, people management and company and industry experience. Business analysis literature discusses the benefits of structural IQ (Richey *et al.*, 2010), the ability to use advanced ICT (Prajogo and Sohal, 2013), basic cost accounting (Okongwu, 2007) and an understanding of complex systems and the cost-to-serve concept (Mangan and Christopher, 2005). Business-management literature deals with execution ability, such as decision-making, seeing the big picture, setting goals, prioritizing and developing and implementing long-term strategies (Sohal, 2013; Dotson *et al.*, 2015; Gammelgaard and Larson, 2001), in addition to more routine management issues such as planning, organizing and controlling (Thai and Yeo, 2015; Shou and Wang, 2017). The

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people-management literature mentions skills in HRM and the development and supervision of staff as competences in SCM (Bernon and Mena, 2013; Shou and Wang, 2017; Thai and Yeo, 2015). Company and industry experience includes the aspect of previous work experience (Margherita *et al.*, 2009; Gammelgaard and Larson, 2001).

On the *intra-organizational* level, the literature discusses areas of business intelligence, business strategy, resource management and business execution. The wide range of literature on business intelligence discusses generation, dissemination and the use of intelligence (Tokman *et al.*, 2011; Davis and Golicic, 2010; Sangari and Razmi, 2015), both in terms of knowledge landscape (Kayakutlu and Büyüközkan, 2010) and information sharing with customers and suppliers (Das and Narasimhan, 2000). The literature furthermore discusses the ability to monitor and track performance (Bowersox *et al.*, 2000), with value-stream analysis and market analysis as two applications (Parry *et al.*, 2010). The literature on business strategy discusses knowing what to do, pointing at competence in supply chain risk management (Ellinger *et al.*, 2015), sourcing without leaking competence (Parry *et al.*, 2006; Drejer and Sørensen, 2002) and the alignment of processes and synergy creation; in brief, how to rethink and restructure the supply chain strategy according to current and future business (Chikán and Gelei, 2010). Resource management deals with how to manage business strategies (in terms of cost) (Halley and Beaulieu, 2009; Perunović *et al.*, 2012) and talent management (Kern *et al.*, 2011). Finally, the literature on business execution discusses how to actually execute the business, such as how to manage change (Halley *et al.*, 2006) and how to implement the organizational response to market changes (Ngai *et al.*, 2011).

Literature on the *inter-organizational* level discusses two aspects of competence in SCM in the managerial element, namely, information management and business management. The information-management literature discusses characteristics such as knowledge channels and how to transfer, recombine and/or create knowledge among supply chain partners (Rosenzweig and Roth, 2007), whereas the business-management literature discusses how to manage and share costs and risks between each party (Ferrer *et al.*, 2011), and the degree of joint decision-making (Ha *et al.*, 2011).

4.3.4 Behavioral competence in supply chain management

The behavioral competence element can be considered the soul of SCM, and although the literature reviewed presents a broad spectrum of characteristic aspects of competence, their achievement might entail challenges. On the *individual* level, the literature highlights self-management, self-motivation, empathy, leadership, creativity and cognitive skills. The self-management literature includes aspects of time management, integrity, confidence, multitasking and stress-resistance (Gammelgaard and Larson, 2001; Okongwu, 2007; Thai, 2012b), whereas the self-motivation literature discusses personal enthusiasm (Thai, 2012a), result orientation (Kayakutlu and Büyüközkan, 2010) and a trait for continuous learning (Dubey and Gunasekaran, 2015). Empathy aspects consider both self-awareness, meaning comfort in talking about both your weaknesses and strengths, as well as the ability to put yourself in another person's shoes and considering their feelings (Van Hoek *et al.*, 2002). Leadership aspects include role commitment, charisma and the ability to manage change (Bölsche *et al.*, 2013; Kayakutlu and Büyüközkan, 2010), while the creativity aspects highlighted are creativity skills (Dubey and Gunasekaran, 2015) and creative and innovative IQ (Harvey and Richey, 2001). Finally, cognitive skills include problem-solving ability (Kovács *et al.*, 2011) and analytical skills (Harvey and Richey, 2001).

On the *intra-organizational* level, the literature mainly deals with the competence characteristics of change and learning orientation and collaborative orientation. The change and learning orientation aspects are based on the absorptive capacity of the given organization, facilitating both the learning willingness and outcomes and the capacity for change (Ellinger *et al.*, 2015; George and Rangaraj, 2006). The collaborative-orientation literature includes a commitment to SCM and, thereby, a willingness to trust and engage in operations with customers and suppliers and develop alliances (Roth *et al.*, 2008). On the *inter-organizational* level, the literature deals with aspects of cultural orientation, including technological readiness (Richey *et al.*, 2007), commitment to the application of new knowledge among supply chain members (Wang *et al.*, 2008), as well as a win-win orientation and the aim to work hard for the common good (Spekman *et al.*, 2002).

5. Discussion and suggestions for future research

The many aspects and facets of competence found in the two-dimensional framework above might imply that the subject in question has been sufficiently treated by previous research. However, numerous opportunities remain to make a meaningful contribution to the body of knowledge within the broad domain of competence in SCM. The following sections discuss the results and present a rich map and foundation for future research.

5.1 Competence elements in supply chain management

First, the review reveals that functional competences have been thoroughly studied, whereas the behavioral competences have received less attention. The dominance of the functional element is even more apparent when looking at the publications that only cover one or two elements of competence. For publications covering one single element, two of three publications deal with the functional element, whereas publications covering two elements deal with the functional element in more than four of five publications (along with one more element). This might not be a surprise considering the context of this review, which entails a natural strong emphasis on the SCM discipline among the publications, but the disequilibrium has conceptualization implications for the progression of the subject. Competence in SCM touches so many areas that researchers should try to incorporate as many other disciplines as possible; for example, psychology, sociology, education, marketing and organization science. The call for multidisciplinary research is in line with the conclusions of many researchers in the area, such as Thomas (2014), Myers *et al.* (2004) and Van Hoek and

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Wagner (2013). The numerous journals and authors in the review also indicate that competence in SCM is of interest for researchers from a vast array of backgrounds, and future research may well discover additional elements of competence, as well as associated aspects and facets.

In contrast to the above discussion, the present review also reveals that one of five publications actually include all four elements, which indicates that the competence elements are interconnected. To further enlarge and deepen the body of knowledge on competence in SCM, the relationship between competences must therefore be considered, such as combinations and ambidexterity. Considering the multidisciplinary nature of SCM, the competences requested subsequently need to be multidisciplinary in nature; that is, individuals and organizations must excel in a number of competence elements. Researchers should therefore continue to include multiple elements of competence in their studies. Combining competences has also been proposed to create synergies (Derwik *et al.*, 2016), and companies that manage to use an ambidextrous approach and to align operational and entrepreneurial competences have been shown to reach a higher degree of both efficiency and innovation relative to their competitors (Sarkees and Hulland, 2009; Rojo *et al.*, 2016). So far, research on these topics remains scarce, and they present themselves as excellent areas for future research.

5.2 Aspects and facets of competence in supply chain management

Apart from the relationship between competences, there is also a need to delve deeper into each single aspect and facet of each competence, where the framework provides an initial description simply by presenting the context. Business management, for example, is found in the managerial element on both the individual and inter-organizational level, but obviously the content description differs in each context. The aspect of supply chain alignment management is quite surprisingly found on the intra-organizational level. The publications reviewed discusses the integration of demand and supply from the focal organization's point of view, although one would expect this to be discussed from an inter-organizational point of view. From the point of view of the level of analysis, the inter-organizational level in particular has received far less attention than it deserves. This is somewhat surprising in light of supply chains being defined as an inter-organizational phenomenon, crossing cultural and organizational boundaries. Evidently, more research is needed that extends the scope and looks at supply chain alignment management and other aspects based on more than one tier.

5.3 Levels of analysis

The present literature review also reveals remarkably limited research on the potential relations and transfers between the levels of analysis, with few articles involving more than one level of analysis. According to Barnes and Liao (2012), a firm's competitiveness is "tied to enhancing its human capital through the development of the competencies of its employees and by creating unique, distinctive and difficult to imitate core competences". Thus, it is important to transfer people's competences on the individual level to the intra-organizational (and inter-organizational) level. According to Spekman *et al.* (2002), the challenge is to make learning occur throughout the supply chain and in the three levels (i.e. individual, firm and supply chain enterprise levels). Lambrechts *et al.* (2012) pinpoint the role and competences of a leading facilitating actor to promote in-depth joint learning, and thereby creating outcome on a system level. The publication of Kayakutlu and Büyüközkan (2010) is one of few in the review that displays more than one level of analysis, elaborating on individual, team and organizational levels. This deficiency leads to the following questions:

Q1. What should the supply chain organization structure look like to support competence transfer?

Q2. How can HR support individuals and the organization itself?

These and other questions need further attention, partly through research that embraces more than one level of analysis. In addition, a possibility exists to refine and add levels of analysis and to develop an even more detailed framework, considering a number of levels not explicitly put forward in this review. First, multiple dimensions of levels remain to be found in the intra-organizational level, ranging from the team level to the level of the entire corporate group. Second, the inter-organizational level could be divided into upstream or downstream categories. Finally, although this literature review unearthed publications on the national level, they were excluded due to subject framing in the screening process.

Not to be forgotten is that the aspects and facets presented in the framework are contemporary and mirror the competences in focus over the past 15 years. These aspects and facets have altered in accordance with the evolution of SCM (Bernon and Mena, 2013) and will continue to do so. Historically, technical developments have profoundly influenced the prerequisites for SCM. In the future, the most critical factor for supply chains is proposed to be people (Sweeney, 2013; Thomas, 2014). This implies that future research should focus on softer competences to update the framework, and this calls (again) for a multi-disciplinary approach, primarily involving the psycho-social discipline.

5.4 Development of competence in supply chain management

Just as the field itself develops and requires updated sets of competences, the actual development of competence is another area that merits research. According to Bernon and Mena (2013), the educational needs of supply chain practitioners have evolved from acquiring technical competency-based training to obtaining support for "wider strategy deployment and change management programmes within organisations" (Bernon and Mena, 2013). The underlying reasons for this transformation have led to a current mismatch between existing and required competences for supply chain practitioners (Sohal, 2013), creating a need for advancing and expanding the curriculum (Van Hoek and Wagner, 2013) and for exploring the relationships between academic institutions and customers of executive education (Bernon and Mena, 2013). Gibson *et al.* (2016) have searched

for enablers to accelerate SCM learning in integrated contexts (university and industry), but more remains to be done.

Publications in this literature review that explore the required competence profile of supply chain professionals comprise various sets of individual SCM competences. However, none of these sets are the same, nor do frequent references exist between them. This supports our notion that the concept of competence in SCM is vague and poorly defined. We claim that our framework helps to give a more unified picture of competence in SCM, and that this benefits competence development in SCM. Possessing a clear picture of the desired profile will simplify the work of developing and achieving that profile. Currently, many of the desired competences identified in the literature are absent from academic course syllabuses and from a number of academic SCM programs. The same applies for other types of competence development, such as in-service training.

Despite the existence of research on competence development in SCM at the individual level, very little research describes the development of competence in SCM at the organizational level. The majority of the publications reviewed have an ex-post perspective, i.e. they evaluate *what* competences are or have been of interest and neglect to discuss or analyze *how* these competences were developed (ex-ante perspective). Based on the fact that competence in SCM leads to business improvements both operationally and financially, this lack of understanding calls for rigorous research and encompassing endeavors to explore ways to achieve it. In the light of a forecasted shortage of supply chain talent (Van Hoek *et al.*, 2002), along with the paradox that companies requiring SCM competence are not preferred employers (Blanchard, 2011), no reason is apparent for not accepting this challenge. Finally, to prioritize among all the competences identified in the review, it would be of interest to explore and determine the financial implications of specific competences in SCM and their relations. Bowersox *et al.* (2000) were pioneers in the field, but subsequent research on the financial implications is limited. It either focuses on a single specific competence like trust (Stuart *et al.*, 2012) or takes a general perspective on competence in SCM as a whole (Ellinger *et al.*, 2011; Ellinger *et al.*, 2012).

6. Conclusions

This paper provides an integrated view of competence in the SCM field by providing a framework for identification and classification of the key content of the subject. A systematic literature review was conducted to develop a more coherent body of knowledge and provide a cohesive view of the fragmented and diverse landscape of the literature on competence in SCM.

6.1 Implications for research

Of significance, the results help to resolve the present ambiguity and complexity of the concept of competence in the SCM literature. This work furthermore provides an important foundation for future examination of the subject and for building theories in the area, and proposes a significant number of suggestions for future research that awaits attention from scholars from various disciplines. Moreover, the results alert researchers to complementary studies outside their own "customary" domains of expertise. Thus, this work makes important contributions to the understanding and development of the research field of competence in SCM. The key contributions of this work to the literature are:

- identification of methodologies, research streams and the evolutionary timeline of literature on competence in SCM;
- classification of literature according to level of analysis (i.e. whose competence) and elements of competence (i.e. the type of competence);
- development of a framework to present aspects and facets of competence in the SCM literature; and
- implications for future research.

6.2 Implications for managers

From a managerial point of view, this literature review offers no silver bullet to improve competence in SCM. Instead, it reveals the complexity of the subject and highlights challenges that need to be addressed. The proposed framework displays a wide range of competences on various levels. Companies need to consider the full range of competences (and not only single elements or aspects) as well as attempt to enhance competence on all levels of analysis from individual to inter-organizational level. By doing so, they can secure necessary competences for improved outcomes on all levels. The framework can also support academic program leaders and HR managers in the process of developing relevant programs and training sessions by highlighting the full range of competences needed. The framework can also be of guidance to HRM staff in the recruiting process. HR personnel are usually quite knowledgeable about law and psychology, but less so about competence success attributes in SCM. The literature review provides knowledge of and insight into all dimensions of competence in SCM. It can furthermore support managerial discussions on the current competence status and assist in developing competence plans for the future.

6.3 Limitations and concluding remarks

As with any research, the present work has limitations. The findings of this review are based on a limited number of publications and disciplines and should therefore be confirmed and further developed by other researchers who can independently classify sets of publications, choose larger samples, use other databases and include publications in languages other than English. This review is also limited to competence in SCM and thus excludes nearby subjects such as talent and capability. In addition, knowledge development must also pursue endeavors that in turn will assist practitioners and stakeholders to better understand the emerging area of competence in SCM.

To conclude, this review does not propose a definition of competence in SCM because such an attempt would be a life-long mission and would not simplify the complexity associated with competence as such. However, this review does present an integrated view of what constitutes competence in SCM literature and attempts to develop a common language and understanding of the subject and how this translates into practice. This review of the literature shows clearly that more research is needed on the subject. Competence in SCM is constantly evolving, which calls for a continuous re-evaluation of the content in the framework, particularly through multidisciplinary research. Also needed is

more research with an ex-ante perspective, that is, how to develop such competences and transfer them between levels of analysis.

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Appendix 1

Table AI Sources in the review and publications

Journal	No.
Supply Chain Management: An International Journal	7
International Journal of Logistics: Research and Applications	6
International Journal of Production Research	6
Journal of Business Logistics	5
Journal of Supply Chain Management	5
International Journal of Production Economics	4
Supply Chain Forum: An International Journal	4
The International Journal of Logistics Management	4
International Journal of Operations and Production Management	3
International Journal of Physical Distribution and Logistics Management	3
International Journal of Technology Management	3
Journal of Operations Management	3
Business Process Management Journal	2
Industrial and Commercial Training	2
Industrial Marketing Management	2
International Journal of Logistics Systems and Management	2
Journal of Marketing Channels	2
Supply Chain Management Review	2
Benchmarking: An International Journal	1
Decision Sciences	1
Enterprise Information Systems	1
European Journal of Training and Development	1
Global Business and Organizational Excellence	1
Global Journal of Flexible Systems Management	1
Integrated Manufacturing Systems	1
International Journal of Business and Information	1
International Journal of Computer Integrated Manufacturing	1
International Journal of Continuing Engineering Education and Life-Long Learning	1
International Journal of Information Technology and Management	1
International Journal of Learning and Change	1
International Journal of Procurement Management	1
International Journal of Research in Commerce, Economics and Management	1
International Journal of Shipping and Transport Logistics	1
International Journal of Supply Chain Management	1
International Journal of Value Chain Management	1
Journal of Engineering and Technology Management	1
Journal of Enterprise Information Management	1
Journal of General Management	1
Journal of Humanitarian Logistics and Supply Chain Management	1
Journal of International Management	1
Journal of Management Studies	1
Journal of Strategic Information Systems	1
Journal of Technology Management and Innovation	1
Journal of the Academy of Marketing Science	1
Journal of Transportation Management	1
Journal of World Business	1
Long Range Planning	1
Problems of Management in the 21st Century	1
Production Planning and Control	1
Quality Assurance in Education	1
Scientia Iranica	1
Total	51 unique (98)

Appendix 2

Table AII Authors in the review and publications

Author	No.	Author	No.	Author	No.	Author	No.
Richey	6	Bowersox	1	Hsu	1	Rogers	1
Ellinger	4	Chiurciu	1	Kovács	1	Rosenzweig	1
Halley	4	Cho	1	Kusaba	1	Roy	1
Beaulieu	3	Christoffersen	1	Lado	1	Saglietto	1
Chen	3	Closs	1	Lalwani	1	Salvador	1
Schoenherr	3	Cox	1	Laosirihongthong	1	Samuel	1
Thai	3	Dapiran	1	Larson	1	Sangari	1
Adams	2	Das	1	Lembke	1	Santa	1
Christopher	2	Davè	1	Leong	1	Sauber	1
Daugherty	2	Davis	1	Liao	1	Saxena	1
Ding	2	De Haas	1	Lin	1	Secundo	1
Griffith	2	Dinwoodie	1	Ling-Yee	1	Shin	1
Gunasekaran	2	Dotson	1	Liu	1	Shou	1
Harvey	2	Drejer	1	Lomas	1	Shukla,	1
Hofman	2	Dubey	1	Longoni	1	Spalanzani	1
Johansen	2	Ducq	1	Lutz	1	Spear	1
Kam	2	Elbert	1	Malekifar	1	Spekman	1
Lusch	2	Ellinger	1	Mangan	1	Stank	1
Moser	2	Essex	1	Marcus	1	Stentoft Arlbjørn	1
Narasimhan	2	Feldmann	1	Margherita	1	Storer	1
Nollet	2	Fergusson	1	Maropoulos	1	Stuart	1
O'Marah	2	Ferrer	1	Matthews	1	Subramanian	1
Parry	2	Froehle	1	McSurely	1	Sun	1
Roth	2	Fulconis	1	Mefford	1	Sundaresan	1
Sohal	2	Gammelgaard	1	Mena	1	Suppakitjarak	1
Abidi	1	Garg	1	Miller	1	Sørensen	1
Agarwal	1	Gelei	1	Mills	1	Taghizadeh	1
Ambulkar	1	George	1	Moeller	1	Tan	1
Anderson	1	Gharibi	1	Mollenkopf	1	Taskin	1
Antony	1	Godsell	1	Morgan	1	Taurino	1
Armoutis	1	Golicic	1	Myers	1	Tian	1
Armstrong	1	Golini	1	Møller	1	Tokman	1
Autry	1	Gonçalves	1	Natarajarathinam	1	Torkkeli	1
Barclay	1	Graves	1	Ngai	1	Tummala	1
Barnes	1	Green	1	Nix	1	Turner	1
Baskaran	1	Grønhaug	1	Northington	1	Vaaland	1
Benardino	1	Ha	1	Nørmølle	1	Wadhwa	1
Berlak	1	Haji	1	Ogunmokun	1	Wallenburg	1
Bernon	1	Han	1	Oh	1	Wang	1
Bigras	1	Hanna	1	Okongwu	1	Wang	1
Birou	1	Hardy	1	Olhager	1	Varella	1
Blackhurst	1	Hartmann	1	Paché	1	Weber	1
Blome	1	Heide	1	Park	1	Wemmerloev	1
Boer	1	Hsu	1	Pató	1	Venkatasubramanian	1
Boyer	1	Huo	1	Paulraj	1	Verville	1
Brian Gray	1	Hyland	1	Perry	1	Wheeler	1
Büyüközkan	1	Inman	1	Perunoviá	1	Whipple	1
Bölsche	1	James-Moore	1	Prajogo	1	Whitten	1
Cagliano	1	Jasemi	1	Prakash	1	Wiedmer	1
Cantor	1	Jie	1	Pyne	1	Wieland	1
Caspersen	1	Jüttner	1	Rahman	1	Villena	1
Cattani	1	Kamauff	1	Rangaraj	1	Yeo	1
Chan	1	Kayakutlu	1	Razmi	1	Zacharia	1
Chandra	1	Keller	1	Rexhausen	1	Zhang	1
Chau	1	Kern	1	Ritter	1	Zhao	1
Chen	1	Khan	1	Roath	1		
Chiadamrong	1	Kim	1	Rodrigues	1		
Chikán	1	Klumpp	1	Roe	1		
Total						229 unique (266)	