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Document Version
Accepted author manuscript

Published in:
International Journal of Physical Distribution & Logistics Management

DOI:
10.1108/IJPDLM-02-2017-0120

Publication date:
2018

License
Unspecified

Citation for published version (APA):
Flöthmann, C., Hoberg, K., & Gammelgaard, B. (2018). Disentangling Supply Chain Management Competencies and their Impact on Performance: A Knowledge-based View. *International Journal of Physical Distribution & Logistics Management*, *48*(6), 630-655. https://doi.org/10.1108/IJPDLM-02-2017-0120

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Journal article (Accepted manuscript*)

Please cite this article as:
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Disentangling supply chain management competencies and their impact on performance: a knowledge-based view

– Authors' names blinded for peer review –

ABSTRACT

Purpose – This paper seeks to extend the understanding of supply chain management (SCM) competencies by splitting them into individual and organizational components and measuring their impact on SCM performance.

Design/methodology/approach – Hypothesized relationships are tested using structural equation modeling and bootstrapping mediation analysis based on a multi-national survey with 273 managers while drawing on theory of knowledge management and literature streams of individual supply chain competencies in the fields of SCM and HRM, respectively.

Findings – The analysis reveals that individual SCM competencies and organizational SCM knowledge positively influence SCM performance to a similar magnitude. Moreover, organizational learning enhances individual competencies and organizational knowledge significantly and equally while corporate training programs fall surprisingly short of expectations. The disentanglement of SCM competencies renders HRM's contribution to SCM visible by revealing the impact of HRM and learning practices on competencies, knowledge, and performance.

Research limitations/implications – To validate the findings, future research could apply different research methods such as case studies and focus on more countries to reduce potential methodological and regional biases.

Practical implications – The results suggest that corporate training programs need further development. Organizational learning's strong direct and indirect effects have two main implications: First, it should serve as motivation for organizations to constantly improve their learning capabilities. Second, these only tap its true potential for enhancing SCM performance if they first elevate individual competencies and organizational knowledge.

Originality/value – This is the first paper to distinguish between individual competencies and organizational knowledge on finely nuanced levels. While the organizational knowledge level effect on performance has been studied before, this paper extends this effect to also hold true for the individual level.

Keywords: Supply chain management competencies, Organizational knowledge, Organizational learning, Training, Skills

Paper type: Research paper

INTRODUCTION

It is widely accepted that a company's supply chain management (SCM) capabilities have a positive impact on its performance by decreasing costs, reducing inventory write-offs and increasing revenues (Ellinger et al., 2011; Wagner et al., 2012). Recent SCM research has used a knowledge-based view (KBV)—that considers knowledge as the strategically most important resource of a firm (Grant, 1996)—to investigate the impact of knowledge on supply chain and company performance (Hult et al., 2004; Craighead et al., 2009). These types of studies have frequently focused on the impact of organizational knowledge rather than on the competencies of individuals. Both components are often aggregated into one concept (Hult et al., 2006). However, classical knowledge management research distinguishes between the two dimensions (Felin and Hesterly, 2007).

The oversimplification of knowledge and competencies in the recent SCM literature is problematic because it fails to capture the true locus of the knowledge involved in value creation (Felin and Hesterly, 2007). There is an ongoing debate about the extent to which value is created. Within this divergence among knowledge management scholars, the majority hold the view that company-level knowledge is the locus of value creation (e.g., Kogut and Zander, 1992; Eisenhardt and Martin, 2000). Advocates of competencies at the individual level are in the minority (e.g., Simon, 1991; Grant, 1996). However, the fact that the debate among researchers is still ongoing suggests that it is worthwhile to investigate the separate contribution of individual competencies and organizational knowledge. This topic has not yet been specifically investigated in SCM. Thus far, only Schoenherr et al. (2014) have studied knowledge management on a more finely nuanced level by distinguishing between tacit (intangible) and explicit (tangible) knowledge in supply chains. These authors found that due to its more imperfect mobility, tacit knowledge contributes

more towards achieving competitive advantage. However, their objective was not to distinguish between individual SCM competencies and organizational SCM knowledge, which is the purpose of this paper.

Organizational knowledge is defined as "knowledge beyond the aggregation of individual knowledge" (Nahapiet and Ghoshal, 1998). Other researchers have conceptualized organizational knowledge as the knowledge stored in databases, routines, processes, documentations, manuals and machines (Felin and Hesterly, 2007). In general, organizational knowledge is easily codified and shared with others at practically zero marginal cost. There is a certain overlap with the principle of "explicit" knowledge found in the KBV. Explicit knowledge can be readily articulated, codified, accessed and verbalized (Hélie and Sun, 2010). However, organizational knowledge can also incorporate elements of tacit knowledge (i.e., knowledge that is intangible and difficult to transfer verbally or written such as the Toyota quality culture (Nonaka, 1991) or Amazon's company mindset for innovative supply chain solutions).

On the other hand, individual competencies comprise the knowledge, skills and abilities of personnel that are related to on-the-job performance (Mirabile, 1997). Traditionally, individual competencies and their development have been a key sub-domain of human resource management (HRM) research. There is theoretical and empirical evidence that employee competencies and development affect a company's SCM performance (McAfee et al., 2002). However, academic research has rarely addressed the link between HRM and SCM (Hohenstein et al., 2014). Similarly, practitioners have largely neglected HRM and its impact on SCM (Sweeney, 2013), although an improved understanding of SCM personnel and their traits is critical to supporting important HRM-related activities such as recruitment, succession planning, training and development (John, 2015).

The overarching premise of this research is to shed more light on the relationship between SCM and HRM and how HRM can positively influence a company's SCM performance through knowledge and employee development. Accordingly, the first objective of this paper is to extend the understanding of SCM competencies on a more granular level by splitting SCM knowledge into its individual and organizational knowledge components. The second objective of this study is to uncover the antecedents and the impact of the different knowledge components on SCM performance by developing a comprehensive model of value creation through SCM competencies. These two objectives are approached as follows: The paper first investigates and quantifies the individual SCM competencies and organizational SCM knowledge as focal constructs to SCM performance. Next, it analyzes the impact of organizational learning and corporate training as the antecedents of individual competencies and organizational knowledge.

The hypotheses are tested using structural equation modeling (SEM) with a maximum likelihood (ML) estimation on the basis of survey data collected from 273 supply chain professionals from companies based in Europe.

The remainder of the paper is structured as follows: The next section presents the theoretical basis and development of the hypotheses. We then outline the research design and the methodological approach. Afterwards, we summarize the results of our analysis. Next, we discuss the findings and the final section summarizes the theoretical and managerial implications and concludes.

THEORETICAL BASIS AND HYPOTHESES

The KBV is chosen as the theoretical basis to link SCM and HRM research on competencies. Based on this view, we developed a set of nine hypotheses that together build a model that can be

used to better understand the impact of organizational and individual competencies, respectively, on SCM performance.

The role of HRM, knowledge and learning concepts in the context of SCM

Numerous studies in the management literature have demonstrated a positive impact of HRM on a variety of performance outcomes (e.g., Huselid, 1995). The compelling logic of KBV conceptualizes the motivation for employing and developing highly competent personnel. Drawing on the KBV's foundation in the resource-based view, capable individuals can establish a competitive advantage if their competencies are valuable, rare, inimitable and non-substitutable (i.e., the VRIN criteria) (Wernerfelt, 1984; Barney, 1991; Grant, 1996).

For example, Aguinis and Kraiger (2009, p. 459) show that training enhances recipients' declarative, procedural and strategic knowledge. These authors found organizational performance benefits such as "profitability, effectiveness, productivity and operating revenue per employee." These findings are expected to hold true in the discipline of SCM but require closer observation due to the unique characteristics of SCM. Unlike other traditional management disciplines like sales or marketing, SCM is a relatively new management concept that stands out due to its holistic, global and intercultural orientation (Cottrill, 2010).

One of HRM's primary goals is to develop employee competencies by designing and implementing adequate training and continuing education programs that facilitate change on individual and organizational levels (Vidal-Salazar et al., 2012). In accordance with KBV, Lawler (1994, p. 7) proposed that "there is a need for the development of skill sets that are appropriate and unique to the organization and that will provide core competencies and competitive advantage." Training allows companies to align employee competencies with the competencies that their strategies require and deploy personnel flexibly in an environment of changing activities.

Moreover, employees can only contribute critical capabilities to their teams if their employer has developed the employees' individual skills (Lawler, 1994). Several studies have reported that HRM activities, including training, have a positive effect on a variety of SCM performance dimensions, particularly quality metrics (Jayaram et al., 1999; Ahmad and Schroeder, 2003). Competency development is essential for many management roles, but it is especially vital for SCM, a truly cross-functional profession (Flöthmann and Hoberg, 2017). Gowen and Tallon (2003) emphasize that strengthening problem-solving skills and the ability to work in teams through training is significantly related to later supply chain success. Based on the above findings, we propose the following hypothesis:

H1. Corporate training is positively related to individual SCM competencies.

The literature indicates that learning capability is an important factor in company success (Leonard-Barton, 1992; DiBella et al., 1996). A corporate learning culture/atmosphere facilitated by the top management and HRM practices is often the seedbed of organizational learning capability. Hult et al. (2003) discussed the potential role of organizational learning as a strategic resource in supply chains. These authors found that organizational learning has a positive and direct effect on a set of learning, supply management, management and performance consequences. The arguments noted above can be extended to individual SCM competencies. This notion is supported by general management research: Flores et al., 2010 (p. 645) found that "information becomes knowledge when it is processed by the actor." Hence, individuals assimilate information and then relate it to their previous knowledge and skills to convert it into new facets of their competencies. Spekman et al. (2002) showed, in one of the very few SCM-focused studies on the relationship between learning and competencies, that a learning environment can improve the abilities of SCM's individual members. Therefore, our next hypothesis is:

H2. Organizational learning is positively related to individual SCM competencies.

According to Flores et al. (2010), organizational learning is related to information management. The flow of information is a central element in supply chains: information must be acquired, integrated and distributed internally and across company boundaries. Organizational entities communicate and make crucial decisions (e.g., such as determining order quantities and production schedules) by exchanging information. Various researchers have agreed that information is the basic input for organizational knowledge (Kogut and Zander, 1992; Davenport and Prusak, 1998). In fact, knowledge can be regarded as "the processing of ready-made information" (Nass, 1994, p. 39). Based on the management literature, we assume that organizational learning must first be linked to organizational knowledge and then converted into performance. Common sense dictates that information and knowledge are quite similar, and therefore it is necessary to define the distinction and the connection between information and knowledge. According to Nonaka (1991), p. 16), "information is a necessary medium for formalizing knowledge." The organizational sub-processes of learning can be regarded as a predecessor to organizational knowledge because shared information lays the foundation for developing into knowledge. Accordingly, the following hypothesis is proposed:

H3. Organizational learning is positively related to organizational SCM knowledge.

Previous studies have shown that organizational knowledge can be a strategic resource in SCM. Hult et al. (2006) investigated why some supply chains perform better than others. These authors found that the degree to which strategy and organizational knowledge elements mesh has a direct impact on supply chain performance. Previously, Hult et al. (2004) investigated the impact of knowledge management on cycle time in strategic supply chains and found that the knowledge development process can explain substantial variance. Hult et al. (2007) count knowledge

development among the levers for improving strategic SCM. Overall, the authors concur that knowledge is a valuable, rare, inimitable, and non-substitutable resource in SCM, leading to a competitive advantage. Recently, Schoenherr et al. (2014) showed empirically that knowledge has multidimensional, positive effects on supply chain performance. We also assume a positive relationship between organizational SCM knowledge and SCM performance but do so by considering individual SCM competencies and antecedent factors. Therefore, we propose the following hypothesis:

H4. Organizational SCM knowledge is positively related to SCM performance.

Generally, previous research in the SCM domain centered around the notion that SCM processes are human-centric (Myers et al., 2004) and consequently that employing individuals with strong SCM competencies should translate into both improved employee and organizational performance (Derwik and Hellström, 2017). The human-centricity and the impact on multiple performance metrics make qualified supply chain managers valuable according to the KBV.

Furthermore, there is widespread agreement among researchers and managers that we are facing an acute shortage of qualified supply chain personnel (John, 2015). Such a shortage, coupled with research and anecdotal references that have consistently suggested that supply chain managers need to possess unique competencies that differentiate them from other managerial staff, make qualified supply chain managers also rare. In addition, the fact that SCM has evolved towards a more strategic role suggests that employees who adapt to rapid development have made themselves also highly inimitable (Slone et al., 2007). Since intangible abilities such as adaptability are difficult to train and develop, competitors can be expected to struggle as they seek to replicate highly qualified staff. Despite recent technological advancements and automation in supply chains, qualified SCM staff are even non-substitutable. In fact, advancements have made

qualified staff even more essential because employees need sophisticated levels of education to manage high tech systems that affect the ultimate performance of the supply chain directly. In sum, SCM personnel, measured by their multi-dimensional, individual SCM competencies, can be expected to fulfill the VRIN criteria and contribute to sustained superior performance. Accordingly, our fifth hypothesis is:

H5. Individual SCM competencies are positively related to SCM performance.

Indirect effects of organizational learning and corporate training on SCM performance

Malhotra et al. (2014) reported that mediation analysis is a useful technique for deriving more robust and more insightful conclusions from empirical research that go beyond direct statistical relationships. Mediation analysis can build and test theories on deeper levels, especially by focusing on indirect effects between the modeled factors. We are particularly interested in the indirect effects of organizational learning and corporate training on SCM performance. Previous studies have shown that organizational learning is directly associated with various managerial performance measures. However, to the best of our knowledge, none of these studies have further explored the existence and impact of indirect effects of training and organizational learning on SCM performance. Studying indirect effects are of particular importance because their presence suggests that training and organizational learning have to be transformed to competencies or knowledge first (mediation) in order to improve SCM performance.

Hult (1998) and Hult et al. (2003) showed that organizational learning can be a strategic resource because it positively affects multiple aspects of supply management (e.g., the organization's cycle time and overall performance). However, these studies did not incorporate potential mediators between organizational learning and performance measures. Hult (1998) investigated the effect of organizational learning on purchasing information processing and the subsequent effect on

subjective and objective cycle time. Although information processing is a mediator, Hult (1998) did not analyze the indirect effects of organizational learning on cycle time. Tippins and Sohi (2003) showed that organizational learning acts as a mediator between IT competency and company performance. Therefore, the hypothesized and analyzed relationships between organizational learning and performance measures are also direct (with antecedent factors).

The lack of attention paid to organizational learning as a mediating factor with indirect effects on performance is surprising. The next section shows that organizational learning is an essential pre-condition for knowledge and competencies which in turn have been empirically linked to performance measures. Consequently, organizational learning can be expected to affect SCM performance indirectly (i.e., it is mediated by individual competencies and organizational knowledge components that are modeled as focal constructs). Therefore, we propose our next hypotheses:

H6a. The relationship between organizational learning and SCM performance is mediated by individual SCM competencies.

H6b. The relationship between organizational learning and SCM performance is mediated by organizational SCM knowledge.

Consistent with previous arguments, we can also expect corporate training to have indirect effects on SCM performance. Most HRM studies that have focused on training have suggested a positive effect on competency and capability development. Furthermore, Aguinis and Kraiger (2009) showed that training enhances observable organizational performance measures such as profitability, productivity, and operating revenue per employee. We certainly expect the direct effects of corporate training on competency levels to account for most of the total effect of training

on SCM performance. Corporate training programs are designed to develop human resources and competencies in the first place. With a lag in time, some of the competencies are translated into actual performance. Therefore, based on previous arguments, we propose the next hypothesis:

H7. The relationship between corporate training and SCM performance is mediated by individual SCM competencies.

However, studies have suggested that current training programs still lack the sufficiency and efficiency required for developing the performance-related competencies of supply chain managers in a desirable fashion (e.g., Ellinger and Ellinger, 2014). Consistent with this observation, Ellinger et al. (2008) found a significant positive contribution of formal training to employee-level performance indicators. However, formal training falls short of affecting the organization's bottom-line performance of logistics service providers. This finding remains only partially surprising if it is considered in light of company investments in SCM training. In a recent study, Gibson et al. (2013) determined that SCM professionals only receive limited training in terms of hours and monetary investments in their education. In conclusion, the potential indirect effects of training initiatives on SCM performance are likely to be limited. In contrast, organizational learning has been strongly and directly linked to various SCM-related performance measures, and such learning is also an enabler that creates knowledge in the first place (Hult et al., 2000; Hult et al., 2003). We therefore expect the positive contributions of organizational learning to be translated into actual performance mediated by individual SCM competencies and organizational knowledge. We expect organizational learning's indirect effect to be stronger than corporate training because previous studies have observed a strong link between organizational learning and performance—often stronger than the one between training and development activities. This situation leads to our last hypothesis:

H8: The indirect effects of organizational learning on SCM performance are stronger than the indirect effects of corporate training.

Exploring the magnitudes of effect sizes is important for deriving implications for practice. On the one hand, the findings can help companies to prioritize future measures for improving SCM performance. For instance, if one capability is found to be much more influential in terms of performance, then firms should develop that respective capability before others. On the other hand, the magnitudes of effect sizes also indicate which component possesses more potential for improvement. For example, if the indirect effect of corporate training on SCM performance is rather limited, then firms should realize that they have to re-design and optimize their development programs.

Figure 1 provides an overview of the conceptual model with all of the hypothesized relationships stated and described before. The full model consists of three building blocks. First, corporate training and organizational learning are conceptualized as antecedents that link to our focal constructs in H1, H2 and H3.

Second, H4 and H5 link our focal constructs (organizational SCM knowledge and individual SCM competencies) to SCM performance. Their disentanglement is the premise of this paper. Finally, indirect relationships are modeled (H6a/b, H7, H8) to explore the mediated effects of the antecedents on SCM performance to derive more insightful conclusions beyond a direct statistical relationship.

----------Insert Figure 1 Approximately Here----------

RESEARCH DESIGN AND METHODOLOGY

Questionnaire development and pre-testing

All of our constructs are latent variables that can be measured indirectly. To test our hypothesized model, we followed a two-step approach, as suggested by Gerbing and Anderson (1988). We first developed a measurement model (a confirmatory factor analysis (CFA)) and then tested the relationships between constructs using a structural path model. To ensure the reliability and validity of the measurements, we investigated the management literature for previously employed multi-item measurement scales. The complete questionnaire with references is included as Appendix B. Three subsequent waves of pre-testing with 18 people of various backgrounds—i.e., supply chain executives, a random sub-sample of supply chain managers, and fellow researchers with methodological and functional expertise—resulted in a sound and thorough questionnaire.

Measurement instruments

We carefully selected all of the measures that we used by adopting or adapting them from previous papers after a rigorous literature review that identified the following scales as being a best fit for the study's purposes.

Corporate Training: We adapted items of Ahmad and Schroeder (2003) and Ahire et al. (1996) to measure the corporate training efforts of companies. These items were used in a comparable research setting to measure training effort of companies in SCM context, which ensures a good fit to our study. They are related to budget and resource allocation for training programs and HRM support for employee training, essential prerequisites for successful training initiatives (McKinnon et al., 2017).

Organizational Learning: Measurements used by Flores et al. (2010) were adapted to design the second-order construct for organizational learning. The five first-order constructs of these authors constitute a common body of knowledge and understanding regarding organizations' learning sub-processes that are concerned with information, an essential component of SCM (Lee et al., 1997). We focused on and employed three of the five initial first-order constructs for the following reasons. The three focus-constructs are information acquisition, information distribution and information absorption. We omitted the construct organizational memory because this sub-process is too closely related to organizational knowledge. Memory is the last step of information processing before it becomes knowledge (Flores et al., 2010). The closeness of memory to knowledge might puzzle respondents and add methodological issues with indicators loading on both second-order constructs. The second dimension of Flores et al. (2010) that we decided to omit is information interpretation. Because interpretation is typically a subjective matter on an individual level, closely related to someone's abilities and knowledge, this factor could be confused with the individual competencies construct. Moreover, the three remaining constructs still cover the majority of facets.

Individual SCM Competencies: This construct was based on the seminal work of Gammelgaard and Larson (2001). These authors identified three categories of relevant skills/knowledge of supply chain and logistics managers that are widely accepted now. Based on an exploratory factor analysis, 45 competencies could be classified into three categories: managerial, SCM core and IT competencies. This situation suggests that SCM competencies are indeed multi-dimensional and require measurement by a second-order construct. The phrasing and logic of the items used to measure those factors were adopted from Byrd and Turner (2001).

Organizational SCM Knowledge: To measure organizational SCM knowledge, we adopted the construct of Hult et al. (2006) but made some adjustments. In their paper, Hult et al. (2006) measured "knowledge" with seven first-order constructs, each measured with at least three items. After careful consideration, we dropped four of those seven first-order constructs because—in foresight—their inherent items were too similar to items included in the individual SCM competencies measures. Those items might have accordingly caused interfering cross-loadings. To prevent this situation, we selected the three key knowledge constructs that described organizational knowledge most precisely and accurately. This decision was necessary because one of the primary goals of this paper is to clearly distinguish between organizational and individual knowledge components. Because we still employ 12 items to measure the three remaining sub-constructs—accessibility of knowledge, knowledge intensity and knowledge use—we are confident of the accuracy of this construct.

SCM Performance: The literature provides many different constructs to measure SCM performance. In this study, we used a combination of items used previously by Rexhausen et al. (2012) and Fawcett and Waller (2013). We use six measurement items, which compare the focal firm's performance with the best competitors in terms of supply chain cost, quality, responsiveness, innovation, improvement and overall performance. By employing six measures, we ensure broad measurement of this important endogenous factor and try to capture the different facets of SCM considered to be the most important (Fawcett and Waller, 2013).

Control variables

To avoid omitting variables that may influence and confound the relationships of the key variables in our model, we introduced three control variables (binary coded) to the structural model. First, we eliminated *country* effects by controlling for the country of the respondent's workplace.

Economic, political and cultural differences influence the strategic and operational options of firms and therefore might influence performance (e.g., Bozarth et al., 2009). Second, *firm size* might be related to performance and internal practices. On the one hand, smaller firms might have fewer financial and managerial resources for implementing sophisticated SCM and HRM practices than larger firms (e.g., Cao and Zhang, 2011). On the other hand, smaller firms might be more innovative and efficient at executing such practices. Therefore, to eliminate these potential confounds, we followed the recommendation to control for firm size (e.g., Terjesen et al., 2011) using number of employees. Lastly, we controlled for the *industry affiliation* (based on the industry classification benchmark) that could also have an impact on SCM performance. Different industries are typically subject to different SCM maturity levels due to the degree of impact on overall company performance (Eroglu and Hofer, 2011).

Data sample and collection procedure

To examine our hypotheses, we used databases from the Copenhagen Business School and the Kühne Logistics University containing the contact details of SCM and SCM-related managers. A link to an online survey was sent to potential respondents via e-mail between the end of January and March 2015. As an incentive to participate, we promised to support a charity organization for every questionnaire that was completed. Excluding outdated or incorrect e-mail addresses, we contacted 1,465 potential respondents and received 337 completed questionnaires.

The first item of the questionnaire was a screening question intended to identify knowledgeable respondents and, therefore, reliable data quality (Fowler, 2014). We asked the respondents to identify their level of agreement with the statement, “I am knowledgeable about my firm's SCM, e.g., about their activities and responsibilities in the organization, overall performance indicators, and employee training programs in place.” on a 5-point Likert scale. Only respondents who

"agreed" (4) or "strongly agreed" (5) with that statement qualified for our study. Consequently, 64 participants (strongly) disagreeing (1/2) or who were not sure (3) were eliminated because their knowledge of our research topics and fit to our study were questionable. This elimination step left 273 reliable responses in our final sample. These numbers translate to an effective response rate of 18.8%, which is consistent with comparable studies (e.g., van der Vaart and van Donk, 2008). Table 1 lists the descriptive statistics of our sample. The majority of respondents (76.2%) came from German-speaking countries (Germany, Austria and Switzerland) followed by Denmark (18.3%). The largest share of respondents in terms of company hierarchy came from the middle (42.5%) and lower (23.4%) management levels. These people usually have a good overview of their company's internal SCM and HRM activities and possess reasonable levels of business experience to serve as reliable sources.

Response and common method bias

To account for potential response bias, the means of all responses of the earliest 30 respondents and latest 30 respondents were compared using a two-tailed *t*-test (Lambert and Harrington, 1990; Wagner and Kemmerling, 2010). We found no statistically significant differences ($p < 0.05$). A *t*-test comparison of two descriptive variables (company revenues and number of employees) of the 30 earliest and latest respondents did not furthermore reveal any statistically significant difference. We concluded that response bias is not a serious concern in this dataset.

----------Insert Table 1 Approximately Here----------

This study is a single informant survey that measures independent and dependent variables simultaneously. Consequently, our analysis might be affected by common method bias (CMB) (Guide Jr. and Ketokivi, 2015). Following two remedy techniques proposed by Podsakoff et al. (2003), we applied two statistical techniques to assess the potential threat of CMB: (i) *a priori* by

installing a marker variable in the questionnaire, and (ii) *ex post* by installing a common latent factor in our measurement model. Neither of the two techniques indicated an interfering presence of CMB in our data, giving us confidence to proceed with our analysis.

The measurement model

Estimation method: In our main analysis, we used IBM Amos 22 covariance-based software and ML estimation. Maximum likelihood estimation has been deemed to be the best-fitting choice for theory-testing research settings such as ours (Kline, 2011).

Convergent validity and reliability: We used CFA to test the reliability and validity of our constructs. All measured constructs yielded high Cronbach's alpha values (average = 0.842, [0.746; 0.901]) and composite reliability (CR, average = 0.851, [0.768; 0.905]), exceeding the recommended thresholds (Cronbach, 1951; Hair et al., 2010). Both measures indicated construct reliability. Convergent validity was also positive. The standardized factor loadings were all greater than 0.5 [0.542; 0.932] with an average of 0.783, and all of the loadings were statistically highly significant at $p < 0.001$ (Vickery et al., 2003; Dröge et al., 2004). Two additional heuristics-based approaches also indicated convergent validity. All estimates were at least twice as large as their standard errors (Anderson and Gerbing, 1988), and the average variance extracted (AVE) was above 0.5 for all constructs (Fornell and Larcker, 1981). A summary of convergent validity and reliability measures is listed in Table 2. Summary data on the item level are listed in Appendix A.

Discriminant Validity: To evaluate discriminant validity, we used the inferential χ^2-difference test complemented by a heuristic assessment. The p-values of the 10 possible constrained models versus the unconstrained models had to be below 0.005 to achieve a 5% significance level (Voorhees et al., 2016). Of the 10 possible inferential χ^2-difference tests, the unconstrained model passed seven times and failed the test marginally twice ($p = 0.022$ and 0.035) and significantly

once (p = 0.176). Unfavorable correlations existed between corporate training and the second-order-construct individual SCM competencies. However, a theoretical content-based evaluation of the respective responses should rule out a problematic statistical overlap. The items address very different topics and should therefore not measure the same latent variables accidentally. To further test discriminant validity, we calculated the 95% confidence intervals (CIs) of the inter-construct correlations. Since no 95% CI included a correlation of 1.0, our model demonstrated discriminant validity (Anderson and Gerbing, 1988). The heuristics-based approaches of Fornell and Larcker (1981) pointed in the same direction in each case. The discriminant validity measures are listed in Table 3.

Multicollinearity: We tested for the potential multicollinearity of factors that share a common dependent factor in the structural model as a robustness check. The two highest measured variance inflation factors (VIF) values were 4.6 and 3.6. All other VIFs were less than 3.0. On the whole, these VIF values are rather low (Hair et al., 2010). The combination of low VIFs, mediocre-to-high dependent latent construct R^2 values, high average measurement reliability for the respective constructs and low standard errors of estimates indicates that multicollinearity is not a concern in our analysis.

Model Fit: Our strategy to assess model fit used a mix of global and incremental model fit indices, i.e., model χ^2 with an adjusted p-value determined by Bollen-Stine (1990) bootstrapping and the technique of Fornell and Larcker (1981) to assess the model fit from multiple perspectives. The model χ^2 was = 1109.630, df = 615. In sum, the assessments indicate that our measurement model yields a good fit, which means that our model corresponds well to the data: CFI = 0.943, IFI = 0.943, TLI = 0.937, RMSEA = 0.047 with P-CLOSE = 0.840 (Hu and Bentler, 1999; Kline, 2011; Bollen, 1989).

----------Insert Table 2 Approximately Here----------

----------Insert Table 3 Approximately Here----------

RESULTS

The structural model: direct effects

We used SEM to test our hypotheses regarding the relationships between our constructs. The structural model yielded an acceptable fit: CFI = 0.921, IFI = 0.922, TLI = 0.915, RMSEA = 0.054 with PCLOSE = 0.080 (Hu and Bentler, 1999; Iacobucci, 2010; Kline, 2011). The hypothesis results are listed in Table 4 and shown in Figure 2. None of the control variables had a statistically significant effect on any of the endogenous constructs. However, we retained them in the model for completeness. Therefore, H2, H3, H4 and H5 are all fully supported. The unstandardized regression weights are statistically significant at the $p < 0.001$ level. H1 is only partially supported. Although the effect is statistically significant at the $p < 0.01$ level, the standardized regression weight (SRW) is very low (0.182), particularly in relation to organizational learning's effect on individual competencies (H2). According to Chin (1998), a low SRW (< 0.2) is insubstantial and of low theoretical value. Given that overall company spending on corporate training worldwide was $130 billion in 2013 (Forbes, 2015), its weak effect is particularly surprising. Our findings suggest that the corporate SCM training programs in place today are ineffective. In contrast, the results show that organizational learning is positively and strongly associated with both competencies (SRW = 0.766) and organizational knowledge (SRW = 0.802). This fact means that information acquisition, distribution and absorption are crucial antecedents that facilitate high competency and organizational knowledge levels.

----------Insert Table 4 Approximately Here----------

----------Insert Figure 2 Approximately Here----------

Competencies (SRW = 0.315) and organizational knowledge (SRW = 0.430) positively influence SCM performance. More importantly, they do so at similar magnitudes.

Indirect effects

We next subjected the mediating role of focal constructs within the model to closer scrutiny. Competencies and organizational knowledge mediate between corporate training, organizational learning and SCM performance. Previous studies have demonstrated the direct and positive effect of organizational learning on SCM and supply chain performance (Hult, 1998; Hult et al., 2003). Furthermore, because organizational learning is related to information management, other studies have found empirical evidence that information absorption (Devaraj et al., 2007), processing (Hult et al., 2004) and sharing (Lee et al., 1997) have positive effects on supply chains. We shed further light on the indirect effects using mediation analysis. We also investigated the indirect effect of corporate training on SCM performance, and expected that this effect would be smaller than the indirect effects of organizational learning (H8). To test the mediated effects, we applied the highly regarded bias-corrected bootstrapping approach (Malhotra et al., 2014). The results are listed in Table 5. The indirect effect of corporate training on SCM performance is almost negligible (SRW = 0.057). Therefore, H7 is only partially supported. Organizational learning's indirect effect is relatively high (SRW = 0.586) and highly significant, which fully supports H6a and H6b. H8 is also supported because the mediated effect of organizational learning is considerably larger than that of corporate training. Moreover, mediation is almost evenly split between individual competencies and organizational knowledge.

----------Insert Table 5 Approximately Here----------

The magnitude of the indirect effect of organizational learning on SCM performance through individual and organizational dimensions is further evidence that having information *per se* is only of partial value. Individuals must process and integrate such information into their organization as databases, manuals and procedures. Organizational learning can reveal its full potential and contribute to SCM performance only if it is transformed into knowledge and competencies.

DISCUSSION AND CONTEXTUALIZATION

This section aims to relate our empirical findings back to the literature and discuss them in a contextualized manner. Our empirical results statistically support our hypotheses and confirm the idea of disentanglement of SCM competencies. However, the widely varying magnitude of the effects of training and organizational learning is surprising and requires further investigation.

Based on our empirical results, the positive effect of corporate training on individual SCM competences is surprisingly limited (H1). This finding contradicts our expectations from the literature review (Gowen and Tallon, 2003; Ahmad and Schroeder, 2003; Jayaram et al., 1999) and deserves further discussion. To the best of our knowledge, no study has yet investigated the corporate SCM training of European companies in detail. However, the Council of Supply Chain Management Professionals (CSCMP) studied SCM talent development practices of American companies and uncovered potential explanations for the shortfall in training (Gibson et al., 2013) that should be transferable to European companies as well. Our findings support many of the authors' conclusions. First, Gibson et al. (2013) highlight that the most popular current training methods are hands on: 76.2% of companies use "on-the-job functional training," but only approximately one-third work with certification from universities and professional organizations. That notion was recently supported by similar findings by McKinnon et al. (2017). These authors investigated logistics competencies and training on a global scale. The CSCMP study also showed

that budget and time allocation for corporate training appears to be one source of poor training performance. The median budget for SCM executive training is $3,405 and averages 37.8 hours per year; the corresponding figures are $1,000 and 30.4 hours per year for entry-level employees. This training gap persists despite the fact that new hires are heavily involved in operations using high-end IT systems and SCM concepts. Consequently, they are more likely to require more frequent in-depth training. Although some leading organizations have realized the importance of SCM training, most organizations still do not invest in training programs (Gibson et al., 2013).

The strong influence of organizational learning on individual competencies (H2) and organizational knowledge (H3) provides empirical evidence for the hypothesized positive impact of companies' information management. In their comprehensive paper used to develop our measurement instruments for organizational learning, Flores et al. (2010) provide interesting suggestions about the key prerequisites for organizational learning practices. They identify participative decision-making, organizational openness, learning orientation and transformational leadership as crucial improvement levers for one or more sub-processes. For example, if organizations promote a high level of participative decision-making among their employees, then employees are more likely to feel free to speak their minds and share experiences (Hult et al., 2000). This corresponds to a positive effect on information absorption (Flores et al., 2010). Accordingly, companies that emphasize organizational openness typically provide an environment of information access and open communication that accepts debate and conflicts as a problem-solving approach while emphasizing information distribution and absorption.

One of our goals was to split the broad term "SCM competencies" into more easily digestible components. Accordingly, we split "knowledge" as used in the literature into its individual and organizational facets to explore their separate contributions to SCM performance (H4 and H5).

We found that both dimensions contribute similarly to various SCM performance indicators. This finding contradicts knowledge management research that has found evidence in studies across management domains for the hypothesis that organizational knowledge is more valuable than individual knowledge (Kogut and Zander, 1992; Eisenhardt and Martin, 2000). Our results suggest that SCM is indeed special among management domains and that SCM personnel deserve special attention. Based on their personal experience and knowledge, supply chain personnel need to interpret information to ensure that they can make informed decisions. This fact is particularly true in situations in which only a limited number of standardized processes exist. For example, during the implementation of new SCM processes (e.g., new product launches), the responsible employees' contribution is highly important: SCM tools need to be developed from scratch and employees need to understand uncertainties such as unclear customer demand and the sudden appearance of supply glitches. These uncertainties force SCM personnel to be alert and react swiftly to upcoming issues. Once a process is in place and more streamlined, human capabilities are free to become involved in new activities.

However, many SCM activities and responsibilities rely and depend on organizational knowledge because they are process driven. Supply chain management is charged with coordinating end-to-end physical, informational and financial flows inside a company and across boundaries with customers and suppliers (Cooper et al., 1997). Although SCM personnel must possess a comprehensive set of competencies, processes can be standardized. In particular, major companies with large production facilities, high capital investments in IT and infrastructure, high SCM maturity levels and products in the later stage of the product life cycle can standardize and automate their supply chain activities. Therefore, SCM knowledge is mainly organizational.

The mediation analysis provides empirical evidence for the hypothesized indirect contribution of organizational learning to SCM performance (H6a/b). These indirect effects are also found to be a much stronger driver of SCM performance than corporate training (H8). The managerial implications point to diverging directions. First, it suggests that companies with limited resources and capacities should focus on facilitating a fruitful organizational learning environment first before they consider fully re-designing their SCM training programs. On the other hand, if companies already possess strong organizational learning capabilities, advancing their SCM training initiatives might leave more room for developing the SCM competencies of the personnel.

Our findings extend previous research that studied organizational learning's direct link to performance metrics. In particular, we add two new layers to the findings of Hult et al. (2003) that organizational learning can constitute a strategic resource in supply chains. First, Hult et al. (2003) found that organizational learning has positive direct effects on a set of learning, supply, management and performance outcomes. We find a positive effect on different SCM performance metrics, extending the list of positive facets incorporated in organizational learning. Second, and even more interestingly, we find such strong effects even in indirect relationships. In particular, these findings suggest that organizational learning fully reveals its potential by supporting the creation of organizational knowledge and upskilling of individual competencies. The finding that organizational learning constitutes not only an important direct driver but also a mediator for performance confirms its strategic role in supply chains.

CONCLUSION

Contributions to the literature

The theoretical contributions of this study are manifold. Most importantly, it takes a multidisciplinary approach to integrating HRM concepts into the SCM literature, responding to recent calls stressing the need for more HRM-related research in the context of SCM (Fisher et al., 2010). This request was fueled recently by studies that indicated a severe global shortage of qualified talent (John, 2015). The problem hereby is two-fold: First, existing personnel often lack the competencies required for the job. Hence, their competencies need to be developed which increases the importance of HRM activities in SCM. Secondly, there are simply too few people to fill newly created SCM jobs. Hence, this scarce resource—talented personnel—must be used most effectively and efficiently. In sum, we must understand multiple aspects of HRM such as competencies, knowledge, learning and training better to determine appropriate counter measures for the talent shortage. In that regard, we introduce a comprehensive model on value creation that uses the KBV as theoretical foundation. Our model enriches the conceptual understanding of SCM competencies because the existing literature has neither differentiated between individual and organizational aspects of SCM competencies nor investigated their separate contributions to SCM performance. We find evidence that organizational SCM knowledge and individual SCM competencies fulfill the value propositions conceptualized in the KBV by recognizing them as VRIN. Therefore, both knowledge components qualify as a potentially competitive advantage. More specifically, our results suggest that both components are important to drive performance. We accordingly draw the conclusion that the characteristics and pre-requisites of these components should be studied with additional research.

Probably even more importantly, we investigate how both dimensions of competencies can be facilitated and enhanced, thereby following up on previous work of organizational learning and training in SCM (Ellinger and Ellinger, 2014; Hult et al., 2003). Here, the literature is extended in two ways: First, we show that the positive effect of training on individual competencies is surprisingly limited. This finding contradicts previous results (e.g., Ahmad and Schroeder, 2003). Secondly, previous research on organizational learning in SCM is further elaborated. In contrast to previous studies that investigated the (more obvious) direct effects on various performance metrics, this study shows a strong indirect effect via generating organizational knowledge or facilitating the upskilling of SCM personnel. Our paper adds a deeper level of understanding the multi-dimensional facets of organizational learning in SCM context and also suggests that organizational learning and its prerequisites are essential indirect enablers of SCM performance. In sum, our paper shows that all selected concepts should not be treated as isolated elements. Rather, they are connected. Thus, our comprehensive model extends previous research that had investigated these concepts separately.

Managerial implications

The study's findings have three managerial implications. Firstly, the fact that individual and organizational SCM knowledge components affect performance indicators to similar degrees emphasizes that companies cannot afford to focus on developing only one. Rather, companies must develop cohesive strategies to improve both dimensions hand-in-hand. Such strategies appear particularly crucial in the current era of digitalization, which is revolutionizing the way organizations learn (i.e., how they acquire, distribute and absorb information). The availability and richness of big data and the opportunity to perform more advanced analyses bear tremendous potential for creating new organizational knowledge. However, SCM personnel need the right

competencies to filter relevant from irrelevant information, apply the appropriate analytical methods and draw the right conclusions. Having all the organizational knowledge at hand but non-qualified personnel leaves significant potential for SCM performance improvement untapped. This situation leads to the second implication, indicating the strong linkage of our conceptual models:

The results of this study suggest that corporate training programs in general are relatively ineffective at developing the required supply chain personnel competencies and therefore require improvement. We suggest that companies improve their training activities by consulting external resources that are specialized in SCM training program design. Again, digital technologies present new opportunities for improving SCM training by leveraging e-learning platforms, mobile access to training materials, and virtual classrooms to globally connect knowledgeable teachers with the personnel that need training easily and at affordable costs (McKinnon et al., 2017). Additionally, "the opportunity to develop" is a key requirement for most job applicants and strongly drives employee satisfaction. In light of the shortage of qualified SCM personnel, the SCM function cannot afford to ignore this essential criterion for triggering job applications from talent.

Third, organizational learning's strong and direct and indirect contribution has two implications for SCM: (i) Organizational learning should serve as a motivation for constantly improving the information acquisition, distribution and absorption processes; and (ii) information only taps its true potential for enhancing SCM performance if it first elevates individual competencies and organizational knowledge.

Limitations and future research

This study is subject to certain limitations. Due to the complexity of the conceptual model featuring three second-level factors, all first-level factors of organizational learning and knowledge provided in the literature could not be incorporated. Nevertheless, we are confident

that our model captured all of the relevant first-level factors. Moreover, the complexity of the topic also prevented us from including all HRM practices in our model. In response, future research could shift to focus on the impact of other HRM practices on SCM performance such as managing employee behavior, selecting employees and defining job positions. Due to the anonymous nature of the survey, we could not obtain objective and secondary data for measuring the SCM performance of the companies involved. Instead, we relied on subjective respondent information. However, previous research has shown that the performance data obtained through surveys are reasonably reliable compared with actual key performance indicators (Carr and Pearson, 1999). We only addressed potential non-response bias by using late respondents as a proxy instead of real non-respondents. Additionally, the majority of our respondents work for major corporations with over 10,000 employees. This situation means that our results might not necessarily be generalizable to small- or medium-sized companies that operate on different organizational structures.

Aside from the limitations stated above, the study opens up various avenues for further research. Because we found a heavy bias towards American companies in the SCM and HRM literature, more knowledge on the impact of HRM practices in non-American companies' SCM is needed. Due to the lack of academic and public studies on HRM practices in Europe, we were only able to discuss the limited investments and efforts put into SCM training based on the study by Gibson et al. (2013) of American firms.

Furthermore, because this study used an online survey, only a snapshot of a current state was captured. Consequently, a longitudinal, in-depth case study including multiple companies—especially one revealing the dynamic development of SCM competencies—would be a highly interesting avenue for further research. For instance, qualitative studies of companies that are

restructuring their employee development programs to observe and measure key improvement factors over time will be valuable to both research and practice. A particularly important aspect, given the results of this paper, is further research on best practices in topics, methods and impact of SCM training programs. It is essential to understand if and how to leverage trainings for improving individual SCM competencies. Finally, studying the exchange of knowledge and joint organizational learning in supplier-buyer dyads will help to reveal the impact of these factors across company boundaries, thereby extending inter-organizational SCM competency development and our understanding of it.

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APPENDIX A: RESULTS FROM CFA – SUMMARY

DATA FOR INDIVIDUAL CONSTRUCT ITEMS

Construct items	Standardized estimates (factor loadings)	t-values (all significant at p<0.001)
ORGANIZATIONAL LEARNING		
Information Distribution	0.744	9.316
IDIST1	0.672	13.232
IDIST2	0.926	24.053
IDIST3	0.931	--[a)]
Information Acquisition	0.857	--
IACQ1	0.567	8.692
IACQ2	0.814	11.841
IACQ3	0.778	--
Information Absorption	0.775	8.622
IABSO1	0.686	10.258
IABSO2	0.728	11.841
IABSO3	0.817	--
Corporate Training		
TRAIN1	0.783	13.543
TRAIN2	0.843	14.396
TRAIN3	0.802	13.795
TRAIN4	0.792	--
SCM Performance		
SCMP1	0.542	8.135
SCMP2	0.653	9.808
SCMP3	0.643	9.629
SCMP4	0.652	--
SCMP5	0.831	12.013
SCMP6	0.921	12.196

Construct items	Standardized estimates (factor loadings)	t-values (all significant at p<0.001)
INDIVIDUAL SCM COMPETENCIES		
SCM Core Competency	0.988	--
CSCM1	0.776	--
CSCM2	0.717	12.500
CSCM3	0.690	12.009
Managerial Competency	0.854	11.758
CMGMT1	0.809	--
CMGMT2	0.757	13.234
CMGMT3	0.670	11.357
IT Competency	0.709	10.487
CIT1	0.854	--
CIT2	0.875	18.231
CIT3	0.792	15.438
ORGANIZATIONAL SCM KNOWLEDGE		
Knowledge Access	0.682	--
KACC1	0.909	--
KACC2	0.781	14.925
KACC3	0.764	14.447
Knowledge Intensity	0.852	9.040
KINTENS1	0.842	17.406
KINTENS2	0.907	19.943
KINTENS3	0.865	--
Knowledge Use	0.816	8.937
KUSE1	0.819	16.570
KUSE2	0.878	18.679
KUSE3	0.878	--

Notes: 2nd order constructs in capitals

[a)] -- indicates a factor loading that was fixed to 1.0 for identification purposes

t-values from unstandardized solution

Measurement model is estimated using maximum likelihood

APPENDIX B: QUESTIONNAIRE

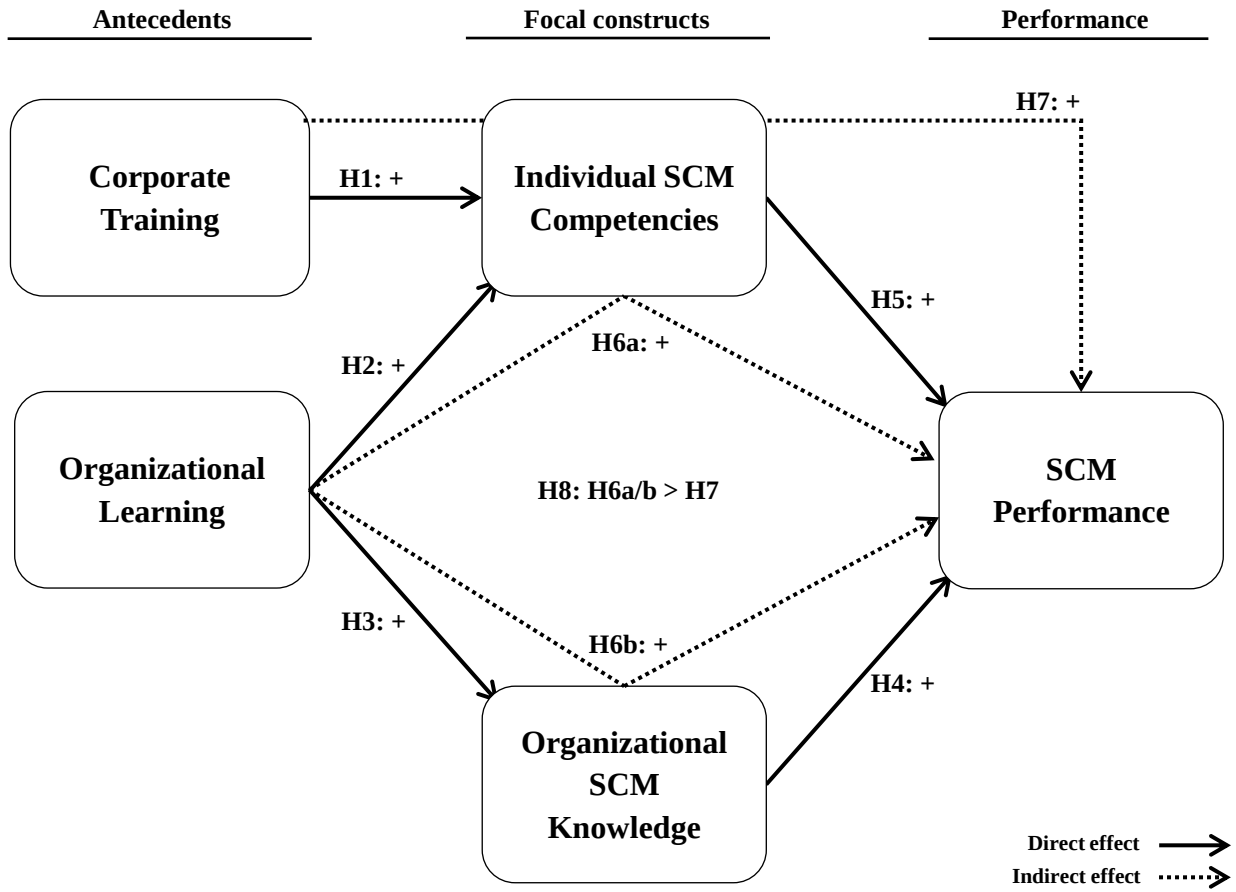
CORE QUESTION ITEMS & CONSTRUCTS – INPUT VARIABLES OF SEM ANALYSIS		
Item	**Question text – All answers on 7-point Likert scale Standard scale: 1 = Strongly disagree, 7 = Strongly agree**	**References**
Knowledge Access		
KACC1	SCM knowledge contained in our organization is very easily accessible when needed.	(O'Reilly, 1980; Hult et al., 2006)
KACC2	On average, it is very easy to obtain SCM knowledge from key people in this organization.	
KACC3	On average, it is very easy to obtain SCM knowledge from databases and documentation in our organization.	
Knowledge Intensity	In our organization...	
KINTENS1	...knowledge intensity is a main characteristic of our SCM practices.	(Autio et al., 2000; Hult et al., 2006)
KINTENS2	...there is a strong knowledge component in our SCM practices.	
KINTENS3	...knowledge of SCM practices is one of our greatest strengths.	
Knowledge Use	Our existing organizational knowledge...	
KUSE1	...identifies aspects of our latest SCM activity that would otherwise have gone unnoticed.	(Deshpande and Zaltman, 1982; Hult et al., 2006)
KUSE2	...enables us to make specific decisions for our latest SCM activity.	
KUSE3	...enriches the basic understanding of our latest SCM activity.	
SCM Performance	How do you rank your supply chain performance compared to your best competitors in terms of... 1 = Much worse, 7 = Much better	
SCMP1	...cost	(Fawcett and Waller, 2013; Gunasekaran and Kobu, 2007; Narasimhan and Das, 2001; Rexhausen et al., 2012)
SCMP2	...quality	
SCMP3	...responsiveness	
SCMP4	...innovation	
SCMP5	...improvement (of overall supply chain performance)	
SCMP6	...overall supply chain performance	
Information Distribution		
IDIST1	Lessons learned by one group are frequently shared by others.	(Flores et al., 2010)
IDIST2	Our company has effective processes for exchanging information between individuals.	
IDIST3	Our company has effective processes to distribute information throughout the organization.	
Information Acquisition		
IACQ1	We constantly benchmark ourselves with our competitors.	(Flores et al., 2010)
IACQ2	We always acquire relevant information from outside our company.	
IACQ3	We always develop new knowledge from existing knowledge.	
Information Absorption		
IABSO1	Top management always integrates information from different organizational areas.	(Flores et al., 2010)
IABSO2	Our employees meet frequently to resolve issues and concerns.	
IABSO3	Our company always motivates sharing and trying to understand management vision through communication with colleagues.	
IT Competency	Our SCM personnel are very skilled...	
CIT1	...in working with databases.	(Gammelgaard and Larson, 2001; Murphy and Poist, 1991; Murphy and Poist, 2007; Giunipero and Pearcy,
CIT2	...in working with large amount of data.	
CIT3	...in working with decision-support systems.	

CORE QUESTION ITEMS & CONSTRUCTS – INPUT VARIABLES OF SEM ANALYSIS		
Item	**Question text – All answers on 7-point Likert scale Standard scale: 1 = Strongly disagree, 7 = Strongly agree**	**References**
		2000; Byrd and Turner 2001)
Management Competency	Our SCM personnel have excellent skills...	
CMGMT1	...to plan, organize, and lead projects.	(Gammelgaard and Larson, 2001; Murphy and Poist, 1991; Murphy and Poist, 2007; Giunipero and Pearcy, 2000; Byrd and Turner 2001)
CMGMT2	...to execute work in a team.	
CMGMT3	...to accomplish multiple assignments.	
SCM Core Competency	Our SCM personnel...	
CSCM1	...have excellent skills in analyzing our supply chain processes.	(Gammelgaard and Larson, 2001; Murphy and Poist, 1991; Murphy and Poist, 2007; Giunipero and Pearcy, 2000; Byrd and Turner 2001)
CSCM2	...have excellent skills in managing information flows.	
CSCM3	...possess a strong cross-functional awareness.	
Corporate Training		
TRAIN1	Employees in the SCM department receive training and development in relevant competencies frequently.	(Ahmad and Schroeder, 2003)
TRAIN2	Human resource management promotes comprehensive training of our SCM employees.	
TRAIN3	Relevant training is part of the company's talent program.	
TRAIN4	Resources are always available for employee training in our SCM department.	
Marker Variable for CMB Testing	Please indicate the strategic supply chain priorities for the main product line	Wagner et al. (2012)
	We always maintain buffer inventory of parts or finished goods.	

DEMOGRAPHIC QUESTIONS		
Demographic Scope	**Question**	**Scale**
Business Experience	How many years of professional experience do you have (without apprenticeships or internships)?	less than 2 >2-5 >5-10 >10-25 more than 25
Company Experience	How many years have you worked for your current employer?	less than 2 >2-5 >5-10 >10-25 more than 25
Industry	In which industry does your current company operate? (if you are employed in a major enterprise operating in multiple industries, please indicate the sector of your BU.)	*Industry classification benchmark (ICB) list*
Company Employees	How many employees work for your company?	1-50 51-500 501-1,000 1,001-10,000 more than 10,000
Company Revenue	What was the approx. revenue of your company last years?	below 10mn 10-250mn >250mn-1bn

DEMOGRAPHIC QUESTIONS		
Demographic Scope	**Question**	**Scale**
		>1-10bn above 10bn
Hierarchical level	Which management level applies to you best?	Top management (e.g., CSCO, COO, managing director) Middle management (e.g., VP, division leader, head of department) Lower management (e.g., team leader, project manager) No management level (e.g., specialist, expert) Other
Country	In which country/region do you work the majority of your time?	*List of all UN member states*
Personnel responsibility	How many persons are reporting directly to you?	1 to 4 5 to 14 15 to 49 50 to 100 more than 100
Gender	I am…	…male …female

Conceptual Model: factors and hypotheses – Figure 1



Structural Model: direct effects – Figure 2

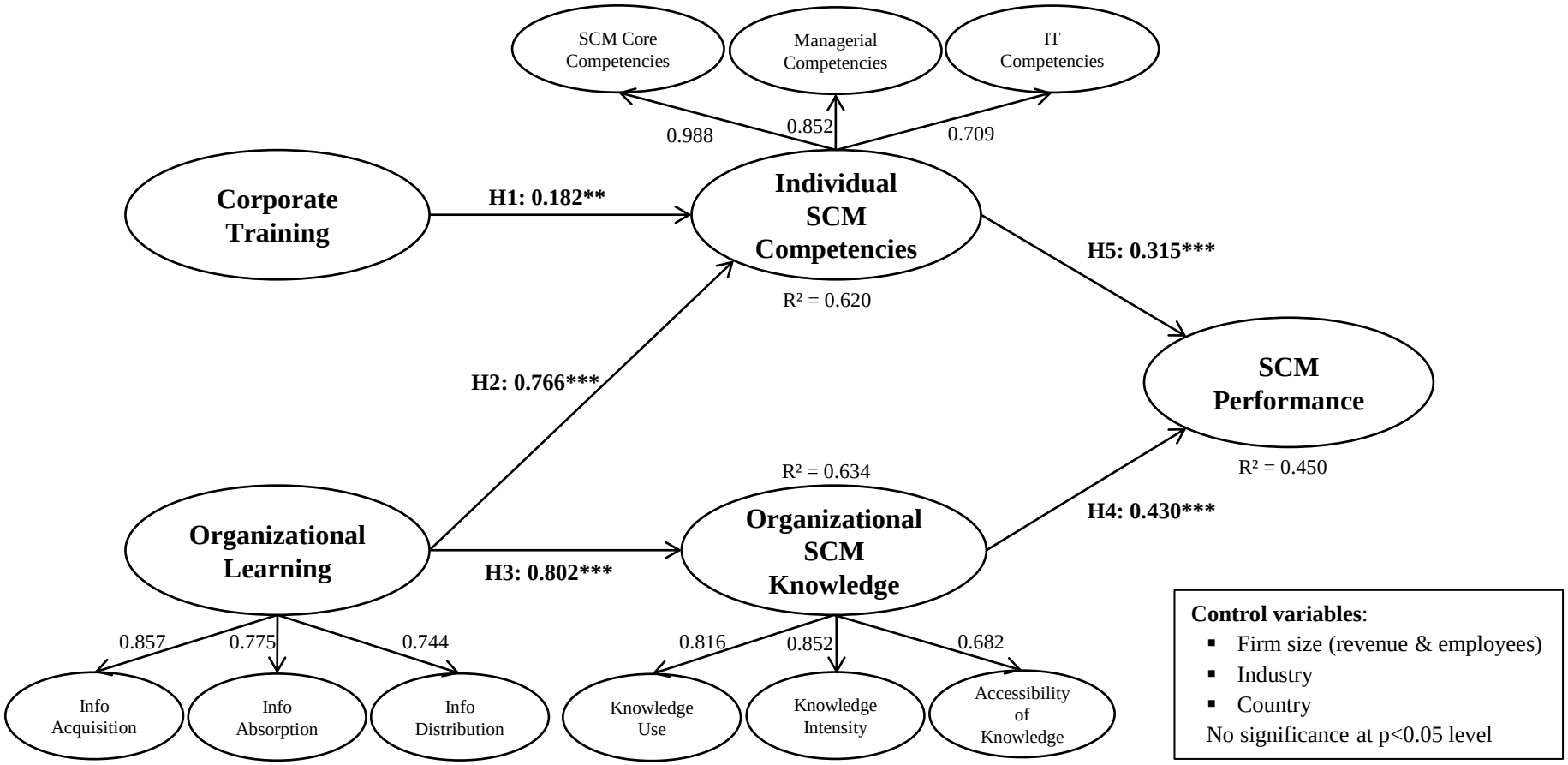


TABLE 1: DESCRIPTIVE SAMPLE STATISTICS

n = 273	n	%		n	%		n	%
Industry			**Company revenue (in euros)**			**Business experience (in years)**		
Automotive & Parts	34	12.5%	Below 10 mn	8	2.9%	Less than 2	12	4.4%
Chemicals	28	10.3%	10-250 mn	39	14.3%	2-5	40	14.7%
Construction & Materials	10	3.7%	>250 mn-1 bn	38	13.9%	>5-10	52	19.0%
Food & Beverages	23	8.4%	>1-10 bn	90	33.0%	>10-25	144	52.7%
Healthcare	36	13.2%	Above 10 bn	98	35.9%	More than 25	25	9.2%
Industrial Goods & Services	49	17.9%	**Company employees**			**Company experience (in years)**		
Oil & Gas	5	1.8%	1-50	7	2.6	less than 2	46	16.8%
Personal and Household Goods	11	4.0%	51-500	27	9.9%	2-5	80	29.3%
Retail	26	9.5%	501-1,000	18	6.6%	>5-10	70	25.6%
Technology	32	11.7%	1,001-10,000	66	24.2%	>10-25	67	24.5%
Telecommunication	7	2.6%	more than 10,000	155	56.8%	More than 25	10	3.7%
Utilities	5	1.8%	**Hierarchical level**			**Country**		
Others	7	2.6%	Top management level	23	8.4%	Austria	13	4.8%
Department			Middle management level	116	42.5%	Denmark	50	18.3%
SCM	178	65.2%	Lower management level	70	25.6%	Germany	145	53.1%
Logistics	26	9.5%	No mgmt. responsibility	64	23.4%	Switzerland	22	8.1%
Procurement/Sourcing	31	11.4%				Other	43	15.8%
Production/Manufacturing	8	2.9%						
Other	30	11.0%						

TABLE 2: RESULTS OF CFA: CONVERGENT VALIDITY AND MEASUREMENT RELIABILITY

n = 273	Mean	SD	CR	Cronbach's Alpha	AVE	MSV	ASV
Organizational Learning	4.55	1.49	0.854		0.660	0.558	0.401
Information distribution	4.13	1.55	0.886	0.875			
Information acquisition	4.67	1.43	0.768	0.746			
Information absorption	4.87	1.40	0.788	0.784			
Corporate Training	4.12	1.69	0.881	0.880	0.649	0.475	0.255
SCM Performance	4.89	1.30	0.866	0.851	0.527	0.415	0.300
Individual SCM Competencies	4.99	1.42	0.902		0.757	0.585	0.382
SCM core competencies	4.88	1.39	0.792	0.791			
IT competencies	4.64	1.48	0.885	0.882			
Managerial competencies	5.45	1.25	0.805	0.802			
Organizational SCM Knowledge	4.63	1.50	0.831		0.624	0.585	0.366
Knowledge access	4.31	1.60	0.861	0.855			
Knowledge intensity	4.68	1.53	0.905	0.901			
Knowledge use	4.89	1.30	0.894	0.893			

All measures are on a Likert scale from 1 to 7
CR = Composite reliability, AVE = average variance extracted
Model fit: CFI = 0.943, IFI = 0.943, TLI = 0.937, RMSEA = 0.047 with P-CLOSE = 0.840

TABLE 3: DISCRIMINANT VALIDITY: FACTOR CORRELATIONS WITH LOWER AND UPPER BOUNDS OF 95% CONFIDENCE INTERVALS

Constructs	OL	CT	SCMP	IC	OK
Organizational Learning (OL)	**0.812**				
Corporate Training (CT)	0.689 0.547-0.791 *0.022*	**0.805**			
SCM Performance (SCMP)	0.627 0.516-0.721	0.430 0.316 -0.555	**0.726**		
Individual SCM Competencies (IC)	0.747 0.636-0.853	0.565 0.46-0.661 *0.176*	0.616 0.507-0.713	**0.870**	
Organizational SCM Knowledge (OK)	0.714 0.592-0.832	0.491 0.348-0.654	0.644 0.529-0.746	0.765 0.636-0.853 *0.035*	**0.790**

Square root of AVE on diagonal in bold
All correlations significant at p<0.001
Italics show p-values of the 3 failed adjusted χ^2-difference tests; all others were below 0.005 (adjusted 5% significance level) and are not displayed in the table

TABLE 4: RESULTS OF SEM: HYPOTHESIS TESTING

Direct relationships	Hypothesis	Support	Standardized regression weight (SRW)	t-values
Corp. Training → Ind. Competencies	H1	Partial	0.182	2.171**
Org. Learning → Ind. Competencies	H2	Full	0.766	7.589***
Org. Learning → Org. Knowledge	H3	Full	0.802	7.069***
Org. Knowledge → SCM Performance	H4	Full	0.430	4.097***
Ind. Competencies → SCM Performance	H5	Full	0.315	3.421***

*** p<0.001, ** p<0.01, * p<0.05
Model fit: CFI = 0.921, IFI = 0.922, TLI = 0.915, RMSEA = 0.054 with P-CLOSE = 0.080
Squared multiple correlations (R^2) for endogenous constructs: Ind. Competencies = 0.620, Org. Knowledge = 0.634, SCM Performance = 0.450
t-values from unstandardized solution

TABLE 5: BOOTSTRAPPING MEDIATION ANALYSIS: INDIRECT EFFECTS

Indirect relationships	Indirect SRW	Bootstrapped 95% CI		Hypotheses
		Lower Bound	Upper Bound	
Mediated by Individual Competencies				
Corp. Training → SCM Performance	0.057**	0.012	0.133	H7: Partially supported
Org. Learning → SCM Performance	0.241**	0.077	0.440	H6a: Supported
Mediated by Organizational Knowledge				
Org. Learning → SCM Performance	0.344**	0.139	0.561	H6b: Supported
Total Indirect Effects				
Corp. Training → SCM Performance	0.057**	0.012	0.133	H8: H6a/b > H7: Supported
Org. Learning → SCM Performance	0.586***	0.474	0.685	

*** p<0.001, ** p<0.01, * p<0.05

Indirect SRW and bounds estimated by bootstrapping 5,000 random samples with the bias-corrected percentile method (95% confidence interval)