

Flöthmann, Christoph H.

Doctoral Thesis

Who Manages Our Supply Chains?: Backgrounds, Competencies and Contributions of Human Resources in Supply Chain Management

PhD Series, No. 2.2017

Provided in Cooperation with:

Copenhagen Business School (CBS)

Suggested Citation: Flöthmann, Christoph H. (2017) : Who Manages Our Supply Chains?: Backgrounds, Competencies and Contributions of Human Resources in Supply Chain Management, PhD Series, No. 2.2017, ISBN 9788793483774, Copenhagen Business School (CBS), Frederiksberg, <https://hdl.handle.net/10398/9433>

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COPENHAGEN BUSINESS SCHOOL
SOLBJERG PLADS 3
DK-2000 FREDERIKSBERG
DANMARK

WWW.CBS.DK

ISSN 0906-6934

Print ISBN: 978-87-93483-76-7
Online ISBN: 978-87-93483-77-4

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BACKGROUNDS, COMPETENCIES AND CONTRIBUTIONS OF HUMAN RESOURCES IN SUPPLY CHAIN MANAGEMENT

PhD Series 02-2017

Christoph H. Flöthmann

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Doctoral School of Business and Management

PhD Series 02.2017

CBS  **COPENHAGEN BUSINESS SCHOOL**
HÅNDELSHØJSKOLEN

Who Manages Our Supply Chains?

Backgrounds, Competencies and Contributions of Human Resources in Supply Chain Management

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Submitted August 30th, 2016 to the
The Doctoral School of Business and Management,
Copenhagen Business School

Christoph H. Flöthmann
Who Manages Our Supply Chains?
Backgrounds, Competencies and Contributions of Human Resources
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1st edition 2017
PhD Series 02.2017

© Christoph H. Flöthmann

ISSN 0906-6934

Print ISBN: 978-87-93483-76-7

Online ISBN: 978-87-93483-77-4

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Acknowledgements

This dissertation concludes four exciting, instructive, and simply beautiful years. This endeavor would have been impossible without the support and encouragement of many people and the knowledge they have shared with me.

First and foremost, I am deeply grateful to Prof. Kai Hoberg for supporting, encouraging, and mentoring me since our first encounter five and a half years ago. During our journey from the University of Cologne via the Kühne Logistics University (KLU) to Copenhagen Business School (CBS), you guided me through my diploma thesis, presentations, seminars, practitioner articles, this dissertation and the papers it comprises. Thank you for your patience with me, believing in me and for making work an enjoyable experience. I guess I owe you a filet béarnaise at The Hussar Grill, Camps Bay!

Next, I would like to express my sincerest gratitude to Prof. Britta Gammelgaard for multiple things: for her openness and excitement to join our paper as co-author, for inviting me to a research visit to beautiful Copenhagen and making me feel at home there, for her continuous support, and most importantly for adopting me as her PhD student despite much extra work that came along with it. Mange tak!

I am heavily indebted to Prof. Jawwad Raja, Prof. Alexander Ellinger, and Prof. Lydia Bals for serving as the assessment committee. I don't take the time and efforts you've invested for granted! Thank you for the valuable feedback you provided that helped to improve the papers for future submissions.

I also thank my friend Prof. Andreas Wieland for the instructive and enjoyable months at CBS and the very helpful comments in the WIP seminar. Great to see that you still hit the gym at "our" Fitness.dk!

Moreover, I would like to thank the KLU's faculty for the fruitful discussions during seminars, courses, and one-on-one-meetings. A famous quote says "*If you're the smartest person in the room, you're in the wrong room.*" Well, I can proudly say that this has never been the case in the last four years for me. I also want to acknowledge KLU's administrative staff for their constant support throughout the years; and their patience when I forgot to hand in a travel application once again. This holds also true for the staff at CBS who supported me perfectly throughout my research visit, enrollment, and submission processes. I owe a great debt of gratitude to the KLU as an

institution for creating an amazing interdisciplinary research environment and for their generous financial support. In particular, I am extremely grateful for the opportunity to have had an international and intercultural experience.

It was certainly a privilege to take trips to Brussels, Dublin, Fontainebleau, Colchester, Singapore, Copenhagen, Edinburgh, Vancouver, Dubai, Cape Town, Bucharest, and Havana on behalf of the KLU during the past four years.

I also gratefully acknowledge the support of Dr. Knut Aliche, Dr. Johan Lundin, and McKinsey & Company throughout my research. Also, I would like to express my appreciation to Prof. Alan C. McKinnon for the instructive time during the World Bank project. It was truly a pleasure to work with you.

Of course, I am indebted to all my fellow PhD students at KLU. Thank you for the helpful feedback during seminars and courses, the pre-tests of my surveys and experiments, and friendly reviews of my papers and this dissertation – but most importantly for your friendship and the fun we had at and after work; especially to the “first cohort” Jannik, Michael, Laura, Olga, and my “roommates” Sebastian, Florian, Jakob, Kristoph, and Niels – I will truly miss you in my next office!

My biggest thanks, however, belong to my family: my parents, Gisela and Henning, and my sisters, Tatjana and Sonsee, for their unconditional love and their continuous encouragement to always pursue my own dreams and paths no matter where they lead me. Last but not least, I thank all my friends I was fortunate enough to meet during the last ten years at university. You truly enriched this exciting period of my life.

Christoph Flöthmann

Hamburg, December 2016

Executive Summary

“Supply chain faces a severe shortage of talent at a time when the demands on the profession have never been greater” (Cottrill, 2010, p. 1).

Motivation

While managers in traditional management functions focus on developing strong expertise to become “specialists” in their own discipline, supply chain managers are a different species: They have to combine a cross-functional understanding of various business fields and multi-faceted competencies to manage the manifold tasks they face on a daily basis. Unfortunately, as globalization has simultaneously increased the complexity of supply chains and the demand for highly qualified personnel, companies are facing a significant undersupply of talent (Cottrill, 2010). Moreover, organizations appear to lack understanding of supply chain personnel and how to support their recruitment, succession planning, and training and development (John, 2015). Surprisingly, at the same time, scientific research on that topic is relatively scarce. In response, the overarching purpose of this paper-based dissertation is to address the research gap between human resource management (HRM) and supply chain management (SCM).

Scope and Purpose

The three independent papers serve multiple purposes by addressing different research topics. The first paper investigates the contribution of the competencies of individuals on supply chain management and firm performance. Drawing on the theory of the knowledge-based view of the firm, an integrated model, which also considers the relationship of individual competencies with organizational knowledge, corporate training, and organizational learning, is developed and tested. The second paper explores and analyzes the careers of 307 supply chain executives. Motivated by career theory, the purpose of the paper is to create new knowledge about the educational backgrounds and career paths that lead to supply chain executive positions. As people

acquire knowledge, skills, and abilities through their education and professional experience, it is worthwhile to investigate their careers as indicators for competencies that decision-makers of today's supply chains embody and offer to companies. The third paper studies the competency requirements of supply chain planners and analysts. Moreover, it identifies and distinguishes managers who make real-life SCM employee selection decisions based on their different preferences to enhance the understanding of the demand on SCM personnel.

Data and Methodologies

This dissertation leverages multiple empirical data sets and methodologies to generate new interdisciplinary knowledge on SCM personnel. In the first paper, structural equation modeling based on 273 knowledgeable survey respondents is used to test the hypothesized relationships. The second paper introduces optimal matching analysis – an innovative research methodology from life course and career research – used to analyze the career paths of 307 supply chain executives. In the third paper, adaptive choice-based conjoint analysis is adopted from marketing research to study the relative importance of competency requirements of supply chain planners and analysts. To achieve that goal, an online experiment with 243 managers making employee selection decisions in practice was conducted. In sum, this dissertation uses an innovative multi-method approach to shine light on different SCM personnel groups from multiple perspectives.

Findings

This dissertation discovers multiple empirical findings. The first paper reveals that individual SCM competencies and organizational SCM knowledge positively affect SCM performance at a similar magnitude. Organizational learning enhances individual competencies and organizational knowledge significantly and equally, while corporate training programs for developing individual competencies fall surprisingly short of expectations. The results also highlight organizational learning's strong, indirect effect on SCM performance through competencies and knowledge. In

the second paper, six career patterns for supply chain executives that differ in terms of the individuals' previous professional experience, educational background, and time needed to arrive in a supply chain executive position can be distinguished. By characterizing the backgrounds and career paths of supply chain executives, SCM is identified as a truly cross-functional profession. In the third paper, SCM knowledge and analytical & problem-solving abilities are identified as the most important competencies for supply chain planners and analysts. Moreover, two types of hiring managers are revealed. The first group is characterized by the pronounced preference for job candidates with extensive SCM knowledge. In contrast, the second group's members prefer candidates with a more balanced competency profile.

Theoretical contributions

The theoretical contributions are manifold. All three papers respond to the suggestion that interdisciplinary research is needed to tackle contemporary supply chain problems (Sanders & Wagner, 2011; Sanders, Zacharia & Fugate, 2013). Simultaneously, recent calls for more research on the people dimension in supply chains are answered (Wieland, Handfield & Durach, 2016) to bridge the gap between HRM and SCM (Fisher et al., 2010). Overall, this dissertation extends the knowledge of people managing supply chains by understanding how they contribute to performance, how their competencies can be improved, what companies demand from them and what education and experience today's supply chain executives have to offer to employers. Moreover, the empirical findings support the selected theories, i.e., the knowledge-based view of the firm and boundaryless career theory. Highly competent supply chain management personnel positively influence supply chain management and firm performance and qualify as a source of competitive advantage. Supply chain executives' diverse biographies show movement through various functions, industries and employers to support the boundaryless career orientation.

Practical implications

Multiple practical implications can be derived from this dissertation. The positive contribution of SCM competencies and the function in general on firm performance should motivate companies to further invest in developing human resources in SCM. The generated knowledge on the diverse backgrounds of supply chain executives and the competency profiles of supply chain planners and analysts heavily support one of the main purposes of HRM, which is facilitating a person-job fit; a significant predictor of company success. Also, an understanding of education and careers supports HR managers in workforce planning, team composition, employee competency management and training design. There is certainly room for improvement for current HRM practices. The ineffectiveness of current training programs in developing competencies and the dissent of desired competency profiles of job candidates indicate that SCM personnel is not well understood in practice. In response, strategic cross-functional alignment and collaboration of SCM and HRM functions should be initiated to better manage people in supply chains in the future.

Dansk Resumé

Baggrund

Mens ledere i traditionelle ledelsesfunktioner har fokus på at udvikle særlig ekspertise, så de bliver specialister i deres egen disciplin, tilhører supply chain managers en helt anden race: De skal kombinere en tværfaglig forståelse af forskellige forretningsområder med multifacetterede kompetencer for at styre den mangfoldighed af opgaver, de står overfor til daglig. I takt med at globaliseringen har øget kompleksiteten i forsyningskæder, og efterspørgslen efter højt kvalificeret arbejdskraft inden for supply chain management (SCM) samtidig er steget, oplever virksomhederne imidlertid en væsentlig mangel på kvalificeret arbejdskraft (Cottrill, 2010). Desuden synes virksomhederne at mangle forståelse for SCM-medarbejdere, og hvordan de kan støtte rekrutteringen af dem og deres karriereplanlægning, uddannelse og udvikling (John, 2015). Samtidig er det overraskende, at den videnskabelige forskning inden for dette emne er relativt sparsom. Det overordnede formål med denne afhandling i artikelform er derfor at se nærmere på den kløft, der er mellem forskningen i HRM (human resource management) og i SCM.

Anvendelse og formål

De tre uafhængige artikler tjener flere formål, idet de omhandler forskellige forskningsemner. Den første artikel undersøger virkningen af enkeltpersoners kompetencer i SCM og virksomhedens resultat. Idet teorien om videnbaseret syn på virksomheden inddrages, udvikles og efterprøves en integreret model, der også tager forholdet mellem individuelle kompetencer og den viden, uddannelse, og læring, der tilegnes i organisationen, i betragtning. Den anden artikel undersøger og analyserer 307 supply chain managers karrierer. Formålet med artiklen, der er inspireret af den grænseløse karriereteori, er at skabe ny viden om de uddannelser og karriereveje, der har ført til ledende stillinger inden for SCM. Eftersom personer tilegner sig viden, færdigheder og evner gennem uddannelse og erhvervs erfaring, er det værd at undersøge karrieren som

indikator for de kompetencer, som beslutningstagere i nutidens SCM besidder og tilbyder virksomhederne. Den tredje artikel studerer de krav til kompetence, der findes til planlæggere og analytikere af supply chains. Endelig identificerer og udpeger artiklen ledere, der tager beslutning om ansættelse af SCM-medarbejdere, på baggrund af deres forskellige præferencer med det formål at øge forståelsen af kravene til SCM-medarbejdere.

Data og metoder

Afhandlingen benytter flere empiriske datasæt og metoder til at skabe ny tværfaglig viden om personale inden for SCM. I den første artikel bruges *structural equation modeling*, baseret på 273 kyndige respondenter, til at teste de hypotetiske sammenhænge. Den anden artikel introducerer *optimal matching analysis*, der er en innovativ forskningsmetode fra livsforløb- og karriereforskningen, til at analysere karrierevejene for 307 supply chain managers. I den tredje artikel anvendes *adaptive choice-based conjoint analysis* fra markedsføringsforskningen til at studere den relative betydning af kompetencekrav til SCM-planlæggere og -analytikere. For at opnå dette mål blev der udført et online-eksperiment med 243 ledere, der ansætter medarbejdere i praksis. I alt anvender denne afhandling en innovativ 'multimetodisk' tilgang til at kaste lys over forskellige SCM-personalegrupper ud fra forskellige perspektiver.

Konklusion

Afhandlingen genererer adskillige empiriske resultater. Den første artikel påviser, at individuelle SCM-kompetencer og en organisatorisk SCM-viden har en forholdsmæssig positiv indvirkning på SCM's præstationer. Organisatorisk læring øger betragteligt og forholdsmæssigt de individuelle kompetencer og den organisatoriske viden, mens virksomhedernes uddannelsesprogrammer, der sigter på at udvikle individuelle kompetencer, overraskende falder igennem i forhold til forventningerne. Resultaterne fremhæver også den organisatoriske lærings stærke indirekte effekt på SCM-præstationer som et resultat af kompetencer og viden. Den anden

artikel ser på seks forskellige karrieremønstre for supply chain managers, der adskiller sig med hensyn til erhvervs erfaring, uddannelse samt den tid de har brugt til at opnå en ledende stilling. Ved at beskrive baggrunden og karrierevejen for supply chain managers påvises det, at SCM for alvor er et tværfaglig erhverv. I den tredje artikel påvises, at viden om SCM samt evner for analyse og problemløsning er de vigtigste kompetencer for supply chain planlæggere og analytikere. Desuden påvises to former af, hvordan ledere ansætter. Den første form er karakteriseret ved en udtalt præference for jobkandidater med omfattende SCM-viden. I modsætning hertil foretrækker repræsentanter for den anden form kandidater med en mere afbalanceret kompetenceprofil.

Teoretiske bidrag

Afhandlingen bidrager med teori på flere fronter. Alle tre artikler kan ses som en reaktion på ideen om, at der mangler tværfaglig forskning for at tackle problemerne i nutidens SCM (Sanders & Wagner, 2011). Samtidig er de et svar på nylige opfordringer til mere forskning i den menneskelige dimension af SCM (Wieland, Handfield & Durach, 2016) for at bygge bro mellem forskningen inden for HRM og SCM (Fisher et al., 2010). Samlet set øger afhandlingen vores viden om de mennesker, der forvalter forsyningskæderne, ved at bibringe en forståelse af, hvordan de bidrager til virksomhedens resultat, hvordan deres kompetencer kan forbedres, hvad virksomhederne efterspørger hos dem, og hvilke uddannelser og erfaringer moderne supply chain managers tilbyder deres arbejdsgivere. Desuden understøtter de empiriske resultater de valgte teorier, dvs. det videnbaserede syn på virksomheden og den grænseløse karriereteori. Yderst kompetent SCM-personale har en positiv indflydelse på virksomhedens styring af sine forsyningsstrømme og resultat og kan ses som kilde til konkurrencefordele. Supply chain managernes meget forskelligartede baggrunde viser, at de bevæger sig gennem forskellige funktioner, brancher og virksomheder, og det understøtter den grænseløse karriereteori.

Praktisk betydning

Der er adskillige praktiske konsekvenser, der kan udledes af denne afhandling. Det positive bidrag SCM-kompetencer og SCM-funktionen i almindelighed giver til virksomheders resultat bør motivere virksomhederne til at investere yderligere i udvikling af de menneskelige ressourcer i SCM. Den viden, der er skabt om supply chain managers meget forskellige baggrunde og om SCM-planlæggerne og analytikernes kompetenceprofiler, støtter kraftigt en af hovedformålene med HRM - nemlig at matche personer og job, hvilket er en betydelig indikator for firmaets succes. Desuden støtter forståelsen af uddannelse og karriere HR-cheferne i deres planlægning af arbejdsstyrken, sammensætning af team, ledelse af medarbejdernes kompetenceudvikling samt tilrettelæggelse af uddannelse. Der er bestemt plads til forbedringer i den nuværende HRM-praksis: Der mangler effektivitet i de nuværende programmer til at udvikle kompetencer og der mangler enighed, når det gælder ønskede kompetenceprofiler for jobsøgere; og dette indikerer, at der ikke er stor forståelse for SCM-personale i praksis. Derfor bør der iværksættes strategisk og tværfaglig koordinering og samarbejde mellem SCM og HRM, således at personalet i SCM-afdelingen kan forvaltes bedre i fremtiden.

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List of Abbreviations

ACBC	Adaptive choice-based conjoint (analysis/experiment)
ASV	Average shared variance
AVE	Average variance extracted
CBC	Choice-based conjoint (analysis/experiment)
CCEA	Convergent cluster and ensemble analysis
CFA	Confirmatory factor analysis
CFI	Comparative fit index
CLF	Common latent factor
CMB	Common method bias
CSCMP	Council of supply chain management professionals
CSCO	Chief supply chain officer
CI	Confidence interval
CR	Composite reliability
CV	Curriculum vitae
EBIT	Earnings before interest and taxes
GLS	Generalized least squares
HB	Hierarchical Bayes
HR	Human resources
HRM	Human resource management
ICB	Industry classification benchmark
IFI	Incremental fit index
JA	Job advertisement
KBV	Knowledge-based view (of the firm)
KSAs	Knowledge, skills and abilities = def. as competencies
ML	Maximum likelihood
MSV	Maximum shared variance
OM	Operations management

OMA	Optimal matching analysis
PCLOSE	“P of close fit” measure
RBV	Resource-based view (of the firm)
RMSEA	Root mean square error of approximation
ROI	Return on investment
SCEs	Supply chain executives
SCM	Supply chain management
SCP&As	Supply chain planners & analysts
SD	Standard deviation
SEM	Structural equation modeling
SRW	Standardized regressions weight
TLI	Tucker-Lewis-index
TMT	Top management team
TtSCE	Time to supply chain executive
VIF	Variance inflation factor
VRIN	Valuable, rare, inimitable, non-substitutable (resources)
YBE	Years of business experience

1 Introduction

“I am convinced that nothing we do is more important than hiring and developing people. At the end of the day you bet on people, not on strategies.”

Lawrence Bossidy, former Honeywell CEO & Chairman

1.1 Motivation

Thirty-four years have passed since the term supply chain management (SCM) was coined. The term refers to the integration and coordination of business processes within and across company boundaries from raw material suppliers to end customers for the purpose of improving long-term performance of companies and the supply chain as a whole (Kransdorff & Oliver, 1982; Mentzer, DeWitt & Keebler, 2001). After researchers from related fields, i.e., operations management, logistics, production and procurement sensed the practical impact of this innovative and holistic business concept, an independent research stream for SCM slowly emerged. Hereby, research focused mainly on conceptualizing SCM problems, optimizing supply chain processes with mathematical models and explaining real-life SCM phenomena, such as the bullwhip effect, empirically (Lee, Padmanabhan & Whang, 1997; Burgess, Singh & Koroglu, 2006; Giunipero et al., 2008). While SCM concepts and systems are very advanced nowadays, research on the people enforcing such concepts remains limited. Despite the fact that supply chains can be considered as human chains (Sweeney, 2013) since people are the ones applying comprehensive SCM models, coping with the day-to-day challenges, and interacting with other departments and external partners on a global scale, knowledge on them remains scarce. It is only recently that the lack of research on human resources (HR) in SCM has received increased attention. Several scholars have alluded to the need for more research on human resource management (HRM) issues in SCM (Fisher et al., 2010; Cottrill & Rice Jr., 2012) for two main reasons.

First, recent developments suggest that the impact of SCM competency on financial firm success has increased over the years (Slone, Mentzer & Dittmann, 2007; Ellinger et al., 2011). Major corporations, such as Wal-Mart and Toyota, have identified their supply chains as “competitive weapons” by exploiting their supply chain competency into dramatic competitive advantages and excellent performance (Hult et al., 2006, p. 459). In response, several papers have investigated the impact of SCM competency on various performance outcomes (Hult et al., 2006; Hult, Ketchen Jr. & Slater, 2004; Ellinger et al., 2011; Ellinger et al., 2012). However, so far, the focus has mainly been placed on “knowledge of the organization” rather than “competencies of individuals” in SCM. Accordingly, researchers have warned that HRM is “about to be missing the boat in terms of recognizing the importance of supply chains” (Fisher et al. 2010, p. 813) and the involved implications for HRM. Such gaps exist because HRM and SCM fields fail to bridge the gap between them (Cottrill & Rice Jr., 2012). As a consequence, “both [...] fields have potentially promising, yet incomplete perspectives on managing people in supply chains” (Fisher et al. 2010, p. 814). Therefore, research should discover the performance contribution of competency on individual levels in supply chains.

The second reason, in addition to the increased strategic importance of SCM competency, is that recent studies and anecdotal evidence suggest that we are facing a severe shortage of supply chain personnel (Cottrill, 2010; John, 2015). Companies are competing for the scarce talents and need to put the right people in place. Given the fact that the complexity of global supply chains has increased continually, it is not surprising that the demands on supply chain managers have changed (Harvey & Richey, 2001; Scott et al., 2015). Since SCM has evolved into a strategic core function, they need to possess different knowledge, skills, and abilities (KSAs) than in the previous years (Richey, Tokman & Wheeler, 2006; Sweeney, 2013; Ellinger & Ellinger, 2014). Moreover, during recent decades many former developing countries have become industrialized

economies. Those new economies have created new global business opportunities, trade lanes and, as a result, new jobs along the entire supply chain. For instance, the US Bureau of Labor Statistics has predicted a 26% increase of SCM and logistics jobs from 2010 to 2020 for the United States alone (Ruamsook & Craighead, 2014). At the same time, the higher demand for a skilled workforce is in conflict with the demographic changes in most developed countries. Almost 50% of the senior-level managers of the “baby boomer generation” will retire during this decade (Wolff, Wageman & Fontaine, 2009), which will seriously intensify the workforce shortage in the SCM sector (Scott et al., 2015). It is, therefore, crucial to generate knowledge about the scarce SCM workforce to cope with the challenges of allocating personnel most efficiently and developing workers according to current and future demands.

For these given reasons, this paper-based dissertation addresses HRM issues in SCM and aims to generate in-depth knowledge about the people who manage supply chains. Simultaneously, it answers the recent call for more interdisciplinary research to tackle contemporary problems in SCM research (Sanders & Wagner, 2011; Sanders, Zacharia & Fugate, 2013).

1.2 Definition of the Key Concepts

1.2.1 Supply Chain Management

Many different definitions and views of SCM exist in the literature and in practice. As a cross-disciplinary concept that connects and integrates activities, personnel, budgets and objectives of multiple entities, many people struggle with grasping its overall definition (Larson & Halldórsson, 2004). Ambiguity of definitions and a blurred perception of the overall purpose of the SCM functions largely exist because its activities are closely-connected to traditional functions, particularly production, logistics, operations management and marketing, all of which claimed ownership of many SCM activities before the existence of this function (Mentzer, Stank & Esper, 2008). Nonetheless, attempts to harmonize the definition of SCM and its core objectives have

reached at least broader consensus in recent years (Gibson, Mentzer & Cook, 2005). Although often used definitions differ in their phrasing and emphasize different facets of SCM, there is at least a sound level of agreement of the core principles: SCM is largely concerned with integrating business processes inside and across company boundaries from raw-material suppliers to end-customers (Cooper, Lambert & Pagh, 1997). More precisely, SCM activities coordinate and manage various flows, most importantly physical flows of goods, financial flows and information flows among all involved stakeholder groups (Mentzer, DeWitt & Keebler, 2001). The multi-facet activities all serve their aligned goal of maximizing customer value and satisfaction. The Council of Supply Chain Management Professionals (CSCMP) settled on the following definition after consulting hundreds of industry experts and academics.

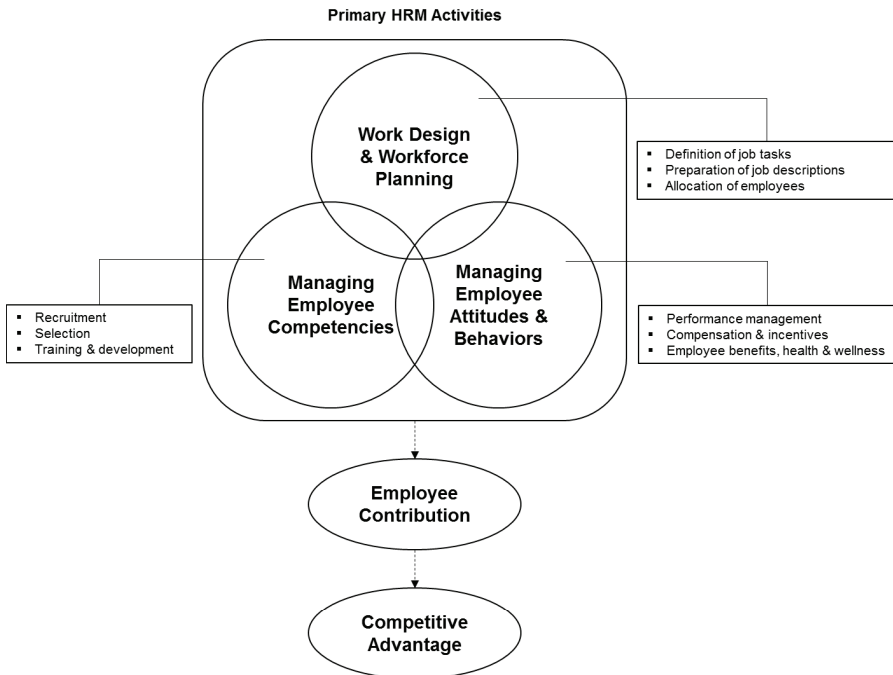
Supply chain management (SCM) encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third party service providers, and customers. In essence, supply chain management integrates supply and demand management within and across companies (CSCMP, 2003; Gibson, Mentzer & Cook, 2005).

1.2.2 Human Resource Management

As implied by the terminology, HRM is responsible for managing an organization's human resources, or, more economically termed, human capital. Some companies refer to it as people management (Pfeffer, 1998). Human capital theory suggests that employees possess knowledge, skills, and abilities that provide economic value to a firm (Youndt et al., 1996). Accordingly, HRM is concerned with managing this resource. HRM can be understood as “the policies, practices, and systems that influence employees' behavior, attitudes, and performance” (Noe et

al., 2014, p. 3). To be more precise, Noe et al. (2014, p. 3) list eight important HRM practices that should be aligned with a firm's business strategy: analyzing and designing jobs, determining how many employees with specific knowledge, skills, and abilities are required (human resource planning), attracting potential employees (recruiting), selecting employees (employee selection), teaching employees how to perform their jobs and preparing them for further assignments (training and development), rewarding employees (compensation), managing their performance, and creating a positive working environment (employee relations). Ideally, organizations raise internal awareness of being in command of all those practices, as empirical evidence has consistently suggested that high-performing HR practices have a positive effect on various individual and organizational performance measures; specifically, higher profitability, share price increases, higher company survival rates, increased sales, higher export growth, increased organizational commitment, higher employee productivity, and lower labor turnover by increasing employees' KSAs and motivation (Combs et al., 2006; Crook et al., 2011; Huselid, 1995; Stone, 2014; Youndt et al., 1996). Correspondingly, poor HRM performance has been linked to poor firm performance empirically (Wright et al., 2005). Moreover, the globalized business environment has made human resources even more critical to organizational success in recent years (Wright & McMahan, 2011).

In line with Noe et al.'s (2014) more nuanced HRM practices, Lepak and Gowan (2010) propose a broader HRM framework that distinguishes three primary HRM activities (Figure 1-1) described hereafter. The ultimate goal of these is to enhance the employee contribution, which is delivered by the application of the employees' KSA on their jobs to increase the firm's competitive advantage in the market (Lepak & Gowan, 2010).

FIGURE 1-1: PRIMARY HRM ACTIVITIES AND COMPETITIVE ADVANTAGE¹

Work design and work force planning are the first critical steps in a well-managed HRM function. To produce a given product or perform a certain service, companies need to pursue a number of tasks. Interrelated tasks are grouped together in various combinations to form certain jobs (Noe et al., 2014). Ideally, those jobs are designed in a way that employees are able to perform tasks and possess responsibilities efficiently in order to add maximum value to the firm. Operationally, that practice incorporates defining the job tasks, preparing job titles and descriptions, and deciding

¹ Adopted from Lepak and Gowan (2010), p. 7.

who and how many employees to allocate for needed jobs to ensure that the right people are in the right position at the right time to meet company goals (Lepak & Gowan, 2010).

Managing employee attitudes and behaviors is mainly concerned with performance management, compensation, and incentives, and employee benefits, health, and wellness, respectively. Performance management refers to measuring an employee's job performance relative to previously formulated job objectives over a certain time period using various metrics. Thus, it involves goal establishment, performance evaluation and employee development tracking to link individual contributions to achievements of organizational objectives (Stone, 2014). Compensation, incentives, employee benefits, health, and wellness are a combination of tools that express the employee's value to the company. HRM is heavily involved in designing those themes. The mentioned elements exert strong influence on the attitudes and behaviors of employees. For instance, receiving a fair salary and additional benefits such as dental care are important tools for recruiting and retaining employees (Lepak & Gowan, 2010). If employees feel undervalued or treated unfairly, their motivation to perform might decrease and they will look for alternative employment opportunities.

Managing employee competencies is the subsequent main component of HRM and it is also the focus of the empirical studies in this dissertation, which will be elaborated on in later sections. Recruitment refers to generating a pool of qualified candidates for job openings, while selection means choosing the best fit among this pool of candidates (Lepak & Gowan, 2010). Moreover, once employed and allocated to a job, HRM supports the employees in their development to maximize the value she or he can provide to the company. Recruitment, selection, and training and development can be broken down to manifold sub-activities for HRM. Needless to say, none of the described primary activities can be successfully performed in isolation. All HRM activities

are interrelated and, thus, must be approached as an integrated process that should be aligned with the overall business strategy (Becker & Huselid, 2006).

Concluding the explanation of the primary HRM activities, it should be evident that HRM plays an essential role in organizational success by managing the entire workforce. In particular, there is mutual empirical evidence that HRM plays a major role in managing SCM employees (Huber & Brown, 1991; Youndt et al., 1996; Jayaram, Dröge & Vickery, 1999). HRM issues in SCM are explained in detail in Section 1.3.

1.2.3 Competitive Advantage

Competitive advantage is the ability to create more economic value than competitors, which should be the ultimate goal of firms (Barney & Hesterly, 2008). Because of the appeal and compelling logic, the idea has served as a foundation for one of the most widely-used theories in management research, the resource-based view of the firm (RBV) and its advancement, the knowledge-based view of the firm (KBV). In their seminal work, Wernerfelt (1984) and Barney (1991) emphasized the application of a bundle of firms' internal tangible or intangible resources to gain a competitive advantage rather than external factors (such as market potential) promoted more regularly in other strategic management theories at the time (e.g., Porter, 1980). The underlying principle of the RBV is conceptualized in Barney's VRIN framework, which states that a resource must be valuable, rare, inimitable, and non-substitutable to qualify as having a competitive advantage. If attempts of competitors to catch up in their disadvantaged areas fail, that resource constitutes a "strategic resource" that serves as a sustained competitive advantage (Barney, 1991). Previous research suggests that highly skilled employees often fulfill those criteria by embodying VRIN competencies (Pfeffer, 1994; Wright, Dunford & Snell, 2001; Becker & Huselid, 2006). Intentionally, the RBV focused on emphasizing the economic value of assets, such as machines, patents or facilities. However, as soon as scholars and practitioners

recognized the concept's applicability to human resources, the RBV became instrumental in bringing "legitimacy to HR's assertion that people are strategically important to firm success" (Wright, Dunford & Snell, 2001, p. 702). Kogut and Zander (1992) and Grant (1996) further developed the KBV as a spin-off theory based on the notion that knowledge is the most important resource in gaining a competitive advantage for many businesses. Specifically, Grant (1996, p. 109) conceptualizes "a company as an institution for integrating knowledge" and employees as the primary actors of knowledge creation and application. As this dissertation is mainly concerned with individual competencies of SCM personnel, two out of the three papers are grounded in the KBV of the firm. In-depth elaborations on the theoretical bases are made in the respective chapters.

1.3 Human Resource Management Issues in SCM

Looking at the history and evolution of the HRM and SCM disciplines, both have more in common than obvious at first sight. Both functions were first considered as support functions to assist business core functions, such as research and development, production, and sales. Since then, both have evolved to a more reputed strategic role in many companies and supply chains (Becker & Huselid, 2006; Hult, Ketchen Jr. & Arrfelt, 2007). The impact of HRM practices was recognized earlier by researchers, however, and given more spotlight in premier academic management journals. Especially during the 1980s and 1990s when companies realized explicitly that their survival was absolutely dependent upon their employees (Schuler & Macmillan, 1984; Wright, McMahan & McWilliams, 1994; Becker & Gerhart, 1996), much HRM-related research was conducted and published (Becker & Huselid, 2006). Tichy, Fombrun and Devanna (1982) paved the way for a better reputation of HRM by stressing the notion that HRM departments actually drive organizational performance based on two main arguments: (i) HRM activities heavily

influence individual performance, particularly productivity and consequently organizational performance, and (ii) effective strategic management is emphasized by effective HRM. The same holds true for SCM. Research shows that SCM activities have a strong impact on overall organizational performance, both positively and negatively (Flynn, Huo & Zhao, 2010; Hendricks & Singhal, 2003), including individual performance (see Chapter 2). Moreover, effective strategic management is enabled by effective SCM (Hult et al., 2006). Comparable to the rise and recognition of HRM, SCM has received increased attention in academic journals in the recent past (Craighead & Meredith, 2008). However, the above described commonalities serve more as a reflection of their similar historical evolutions than a fact-based unification of both disciplines. Naturally, both fields deal with very different topics and serve different purposes. Actually, they could not be much more apart from each other: On the one hand is SCM, a very technical process embedded in core activities of the company; inter alia, the main activities comprise moving physical goods through a complex distribution network and forecasting volatile order volumes to plan inventory levels of products. At the same time, the people behind all those tasks were considered as “executing organs” that must apply the mathematically-developed models and concepts taught in business schools. On the other hand, HRM comprises “softer” sociological and psychological aspects. HRM is concerned with human beings, their attitudes, behavior, development and career paths. Given the different backgrounds, perspectives and research interests, it is not surprising that professionals and scholars of both disciplines live in parallel worlds with limited intersections and collaboration.

Despite numerous calls for more research in the intersection of HRM and SCM, only little research has been published in SCM-related outlets. Between 2001 and 2005 only 4.5% of the articles in three SCM/logistics journals² addressed HRM issues (Murphy & Poist, 2006).

More recently, Hohenstein, Feisel and Hartmann (2014) could find only 109 HRM-related articles in 12 SCM/logistics journals³ from 1998 to 2014 in their comprehensive structured literature review – equivalent to approximately 1.3% of all articles published during that period in those journals. Hohenstein, Feisel and Hartmann (2014) classify those papers into seven research streams⁴ that are described in the following and recapped in Figure 1-2.

Knowledge, skills, and abilities of SCM have been subject to the most HRM-related studies at 88%. This area is concerned with the competency requirements and demands on supply chain personnel. Due to the rapid evolution and increasing complexity of today's supply chains, SCM personnel need to possess different competencies than previously thought, which requires continuous research to update the knowledge of that topic (Hohenstein, Feisel & Hartmann, 2014). Highly-qualified personnel are generally associated with value creation and competitive advantage. Recent studies support the notion that supply chain managers need to possess very diverse sets of competencies to manage the variety of tasks they face on the job (Hohenstein, Feisel & Hartmann, 2014).

² Journal of Business Logistics, International Journal of Physical Distribution & Logistics Management, Transportation Journal.

³ Journal of Operations Management, Production and Operations Management, Journal of Supply Chain Management, Journal of Business Logistics, International Journal of Physical Distribution & Logistics Management, International Journal of Logistics Management, International Journal of Production Economics, International Journal of Production Research, Journal of Purchasing & Supply Management, International Journal of Logistics: Research and Applications, Supply Chain Management: An International Journal, Transportation Research Part E: Logistics and Transportation Review.

⁴ Please note that many papers touch on multiple research streams simultaneously.

Training and development refers to systematic acquisition and development of necessary KSAs to perform a task or improve job performance (Stone, 2014) and has been the focus of 80% of recent HRM articles (Hohenstein, Feisel & Hartmann, 2014). The empirical findings of studies diverge. While the general positive effect of training and development of best-practice programs is undeniable (McAfee, Glassmann & Honeycutt, 2002), many training programs in practice fall short in achieving their ultimate goal, which is developing SCM-specific competencies. This is largely due to insufficient funding and improper training methods (Gibson et al., 2013).

HRM impact on SCM performance refers to HRM's contribution in an SCM context to achieve competitive advantage (53% of HRM papers; Hohenstein, Feisel & Hartmann, 2014). There is general consensus that various HRM practices have a positive impact on SCM performance, e.g., through improvement of competencies (Ellinger & Ellinger, 2014), investment in human capital (Myers et al., 2004) and facilitation of closer human interaction on interpersonal levels across the supply chain (Ketchen Jr. & Hult, 2007).

Education and teaching take a look at the educational side by studying the SCM curricula designed to produce highly-qualified graduates who meet the demands of the industry (Wu, 2007). This topic was touched on by 41% of the papers (Hohenstein, Feisel & Hartmann, 2014). Recently, many curricula have been updated to keep up with the changes of the SCM profession. The studies make several suggestions as to how curricula should be designed and integrated in universities and colleges. For instance, Knemeyer and Murphy (2004) suggest that SCM courses could be integrated in marketing programs to promote the field as more exciting. Also, SCM education should involve companies in their curricula and incorporate experiential learning approaches in order to match SCM graduates' competencies with the changing demands of practice (Gravier & Farris, 2008; Rossetti & Dooley, 2010).

Recruiting and hiring refers to the systematic generation of the largest pool of qualified job candidates with desired KSAs using appropriate selection methods (Gatewood, Feild & Barrick, 2016). Twenty-six percent of the HRM papers have addressed this research topic (Hohenstein, Feisel & Hartmann, 2014). Under consideration of an ongoing shortage of supply chain talent, recruiting and hiring has become one of the main issues in SCM. For example, Gibson and Cook (2001) found that approaches that reach a wider pool of candidates through in-campus recruitment and internship opportunities outperform management search firms.

Compensation and pay studies investigate the payment levels, compensation and incentive structures of SCM personnel in 21% of the 109 HRM-related papers. In general, research indicates lower starting salaries in third-party logistics service providers compared to entry-level SCM positions (Hohenstein, Feisel & Hartmann, 2014). In terms of payment structure, Ahmad and Schroeder (2003) find performance-related compensation to be positively related to long-term operational performance, but insignificant in intangible performance measures.

Global mindset, with a share of 17%, is concerned with a “way of being” beyond classical KSAs, e.g., the open-mindedness, global orientation, intercultural awareness, and cultural diversity of SCM personnel in response to shifting target markets and increasing globalization (Hohenstein, Feisel & Hartmann, 2014). Indeed, in general, researchers concur that supply chain managers must ensure cultural compatibility, awareness and enroll people who can create bridges in global SCM (McCarter, Fawcett & Magnan, 2005; Gammelgaard & Larson, 2001).

FIGURE 1-2: HRM RESEARCH STREAMS IN SCM JOURNALS⁵

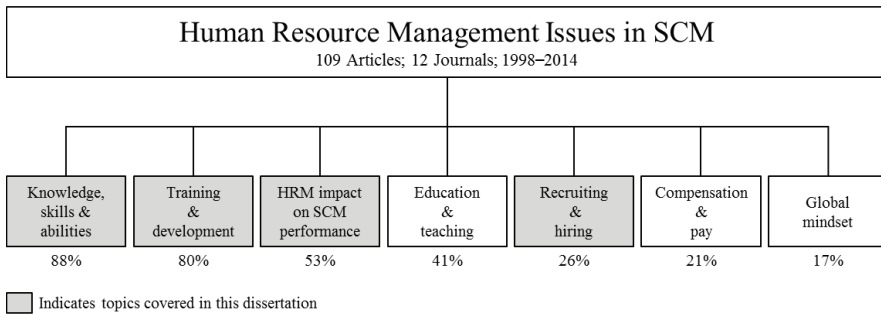


Figure 1-2 illustrates the seven sub-streams and shows their respective shares. This dissertation addresses four of these seven sub-streams simultaneously, i.e., *KSAs, training and development, HRM impact on performance* and *recruiting and hiring* to draw a comprehensive picture of HRM issues in SCM as outlined in the following section.

1.4 Dissertation Outline: Multi-perspective Understanding of People in SCM

This is a cumulative dissertation that is based on three individual research papers. Chapters 2, 3 and 4 represent those studies, which can be read independently. Due to the fact that they are available as stand-alone research papers which demands comprehensibility without knowledge of this dissertation, there is a minimal overlap in the introduction and literature review sections, as they all serve to highlighting the need for more HRM-related research. Table 1-1 provides an overview of the three papers.

The first two papers have been submitted to peer-reviewed academic journals and progressed into the journals’ internal review process. The third paper will be submitted after completing this dissertation. The work was also presented at several academic conferences. This subsection will provide a brief description of these three articles. Chapter 5 will discuss and conclude this

⁵ Adopted from Hohenstein, Feisel and Hartmann (2014), p. 440.

dissertation and attempts to describe its joint theoretical contributions, managerial implications and highlight the importance of HRM issues in SCM as derived from this work. Limitations and future research opportunities are discussed transparently to pave the way for further interdisciplinary research on related topics.

TABLE 1-1: OVERVIEW OF RESEARCH PAPERS

Chapter	Title	Co-authors	Research topics	HRM streams ⁶	Status
2	Individual Competencies, Organizational Knowledge, and SCM Performance	Kai Hoberg & Britta Gammelgaard	<ul style="list-style-type: none"> ▪ Impact of individual competencies and organizational knowledge on performance outcomes ▪ Direct and indirect effects of organizational learning and corporate training 	<ul style="list-style-type: none"> ▪ KSAs ▪ Training & development ▪ HRM impact on SCM performance 	Submitted to <i>Supply Chain Management: An International Journal</i>
3	Career Patterns of SCEs: An Optimal Matching Analysis	Kai Hoberg	<ul style="list-style-type: none"> ▪ Educational and professional backgrounds of SCEs ▪ Revelation of career patterns and drivers of career advancement 	<ul style="list-style-type: none"> ▪ KSAs 	Forthcoming in <i>Journal of Business Logistics</i> , Vol 38. No. 1
4	Competency Requirements and Selection Criteria of Supply Chain Planners and Analysts	None / Single-author paper	<ul style="list-style-type: none"> ▪ Relative importance of six competency attributes ▪ Job requirements for SC planners and analysts ▪ Segmentation of hiring managers with different preferences 	<ul style="list-style-type: none"> ▪ KSAs ▪ Recruiting & hiring 	Ready to submit

⁶ According to Figure 1-2.

The first paper, provided in Chapter 2, sheds light on the contribution of supply chain personnel to SCM and firm financial performance through their individual competencies under consideration of related factors. The study was driven by the following three research questions:

RQ 1: *To what extent do individual SCM competencies and organizational SCM knowledge contribute to SCM and firm performance?*

RQ 2: *How effective are the antecedent factors of organizational learning and corporate training in developing individual competencies and/or organizational knowledge?*

RQ 3: *What are the indirect effects of these antecedent factors on SCM performance?*

To find answers, we use an integrated model that hypothesizes and tests the impact of individual SCM competencies on various performance metrics in relation to organizational SCM knowledge and considers organizational learning and corporate training as antecedent factors. The empirical study is grounded in a knowledge-based view. Based on a trilingual online survey with 273 multinational participants employed in European companies, we apply structural equation modeling to analyze ten hypothesized relationships in our model. Our analysis shows, that individual SCM competencies and organizational SCM knowledge components positively influence SCM performance with similar magnitude. Organizational learning is identified as an essential facilitator of individual competencies and organizational knowledge, while the positive effect of corporate training in developing competencies of SCM staff is surprisingly limited. An early draft of this paper has been presented at the 10th European Research Seminar on Logistics and SCM, April 23rd–24th, 2015, in Copenhagen. At the date this dissertation was published, the article was submitted to *Supply Chain Management: An International Journal* under the working title: **Christoph Flöthmann, Kai Hoberg & Britta Gammelgaard: Individual Competencies, Organizational Knowledge and SCM Performance: A Knowledge-based View.**

In the second article, provided in Chapter 3, we study the professional and educational backgrounds of supply chain executives (SCEs). This corresponds to the empirical analysis of the supply side of talent in SCM, particularly the decision-makers. More precisely, we aim to answer a set of three research questions in this exploratory study:

RQ 1: *What are the educational backgrounds of SCEs?*

RQ 2: *Are there career patterns among SCEs and if so, what are their characteristics?*

RQ 3: *What are the drivers of rapid career advancement into SCE positions?*

Building on career theory, we leverage a unique dataset containing full professional resumes (CVs) of 307 SCEs for our analysis. The data were gathered from the social network for business professionals, XING. We introduce a new methodology into the SCM literature, optimal matching analysis, to reveal hidden career patterns among the individual career paths. Despite the individual nature of careers, we find evidence of six common career patterns that differ, especially in previous functional experience, but also in other career characteristics. Most interestingly, we observe a large share of SCEs with very limited or no previous exposure to SCM. Those executives, however, possess prior leadership experience, which suggests a higher importance of staff responsibility than deep functional knowledge for that position. Earlier versions of this study have been presented at the *9th European Research Seminar on Logistics and SCM*, April 28th–29th, 2014, in Düsseldorf and at the *POMS International Conference*, July 21st–23rd, 2014 in Singapore. At the time of publication of this manuscript, the article was forthcoming in *Journal of Business Logistics*, Vol. 38 No. 1, under the title: **Christoph Flöthmann & Kai Hoberg: Career Patterns of Supply Chain Executives: An Optimal Matching Analysis**. Selective findings of an early version of the academic paper have also appeared in a practitioner article: **Kai Hoberg, Knut Aliche, Christoph Flöthmann & Johan Lundin (2014). The DNA of Supply Chain Executives. *Supply Chain Management Review*, 18 (6), 36–43.**

In the third, single-author paper, provided in Chapter 4, I investigate employee selection and competency requirements for supply chain planners and analysts. Moreover, different groups of managers that make employee selections are identified. More precisely, I intend to answer two research questions:

RQ 1: *What are the key competency requirements of supply chain planners and analysts?*

RQ 2: *What are managers' and firms' preferences when selecting job candidates and are they sufficiently distinct to enable segmentation?*

Based on an adaptive choice-based conjoint experiment with 243 hiring managers, *SCM knowledge* and *analytical & problem-solving abilities* emerge as the most important competencies for supply chain planners and analysts. *General management skills* are perceived as the least important competence category. Additionally, two different types of supply chain managers that select planners and analysts can be distinguished. The first segment prefers candidates with extensive SCM knowledge, valuing that qualification twice as much as their second preferred attribute (*analytical & problem-solving abilities*). The second group has preferences that are more balanced across all attributes. The current draft has been accepted for presentation at the *5th World Conference on Production and Operations Management (P&OM)*, September 6th–10th, 2016, in Havana, Cuba under the earlier working title: **Christoph Flöthmann: Determinants of Hiring Decisions in Supply Chain Management: An Adaptive Choice-based Conjoint Analysis.**

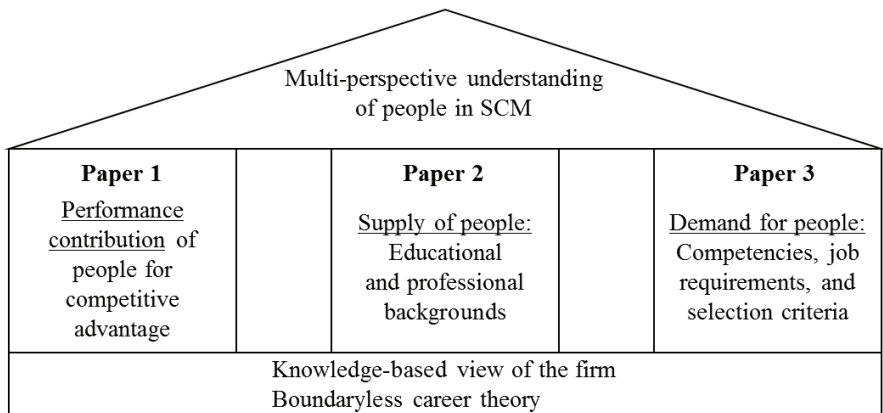
FIGURE 1-3: INTEGRATION OF THE THREE RESEARCH PAPERS

Figure 1-3 visualizes the purpose of this dissertation by integrating the separate papers into one overarching concept. Overall, this dissertation takes a multi-perspective approach to elevate and extend the understanding of people in SCM.

This “big picture” approach is achieved using three steps: First, the contribution of highly-competent SCM employees to various performance outcomes is emphasized in Paper 1. Secondly, Paper 2 studies the supply side of today’s supply chain executives by analyzing the educational backgrounds and professional experience they have to offer companies. Third, the competence requirements, employee selection criteria, and preferences of hiring managers are studied to reveal the demand for supply chain planners and analysts. The theoretical foundation is provided by the knowledge-based view and boundaryless career theory as outlined in detail in the respective chapters.

1.5 Research Design and Empirical Data: A Multi-method Approach

In their seminal paper, Meredith et al. (1989) highlight the need for a wide application of alternative research methods and cross-disciplinary research in operations management (OM), and

presumably SCM, to address contemporary research problems more appropriately. In the best case scenario, knowledge can be accumulated through a continuous cycle of research that consists of three stages: description, explanation, and testing. These stages need to be briefly explained:

Description reflects the earliest stage of research that seeks to report and chronicle situations, phenomena and events. Due to the lack of knowledge to build on, the purpose in this stage is to establish a well-documented characterization of the subject of interest. Although descriptive research is often challenged as not being rigorous enough for consideration as “good” research, it is an essential cornerstone for generating frameworks, concepts, and theories that can be tested at a later stage. A very detailed level of description is labeled exploratory research. Exploratory research can lead to further insights and understanding and give additional meaning to areas of interest or existing knowledge (Meredith et al., 1989).

Explanation represents the second research stage, building on description. At this stage, initial concepts are already postulated, and some action-reaction or cause-effect relationships may be derived. If a set of relationships can be observed and formulated to explain a situation or phenomena, a framework may be constructed as a foundation for further research. Lastly, when the framework or a set of frameworks has repeatedly worked in reality, it might be integrated into a cohesive theory that can be regarded as the most abstract state of explanation (Meredith et al., 1989). In sum, good explanatory research helps to facilitate complete understanding of the subject of interest.

Testing is the last stage in the cyclic process of research. The purpose is to test the concepts and frameworks that emerged from the previous stages and determine which of them are correct and which are false. Often, predictions are made beforehand based on developed hypotheses. This stage is commonly referred to as “true research” due to its ability to support or reject hypotheses

statistically, although this claim does some injustice to the research at the previous stages. After concepts have been tested, the insights lead to more detailed description of a phenomenon or a shift to new aspects that emerged from the testing and need to be described, restarting the research cycle (Meredith et al., 1989).

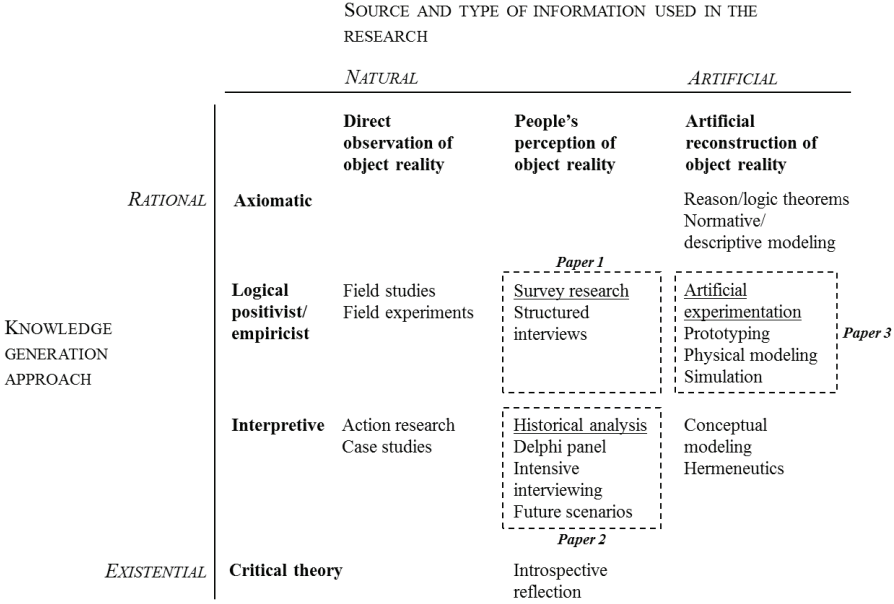
Once, the researchers are aware of their position in the research cycle, they need to identify the appropriate research methods for their purposes. For identification of these methods, Meredith et al. (1989) propose a generic framework for classification. The idea behind this framework is to encourage researchers to use multiple methods to investigate research problems and phenomena from different angles. More specifically, the framework relates four alternative philosophical paradigms to the selection of appropriate research methods by linking the *source and kind of information* and the *knowledge generation approach* (Croom, 2009).

The *rational/existential* dimensions (Y-axis of Figure 1-4) relate to the epistemological structure of the research process itself reflected by the standpoint of the researcher. A *rationalist* uses a formal structure and pure logic as the ultimate measure of truth. An *existentialist*, at the other extreme, perceives the interaction of humans with their environment as the locus of knowledge creation (Meredith et al., 1989). Within this dimensions, four generic perspectives structure the degree of formalism. The *axiomatic* perspective assumes a high degree of knowledge about the unit of analysis or study subject a priori. A classic example from OM would be the economic order quantity model that assumes all input parameters to be known, which leads to a simple calculation of the optimal order quantity. On the other extreme is *critical theory* that is more concerned with “placing knowledge into the broader context of its contribution to social evolution to [...] transcend the contradiction between the way people behave in practice and the way they understand themselves to be acting” (Meredith et al., 1989, p. 307). Between those extreme lies the *logical positivist/empiricist* who assumes that a phenomenon “can be isolated from its context

in which it occurs and that facts and observations are independent of the laws and theories used to explain them” (Meredith et al., 1989, p. 306) and the *interpretive* perspective that includes the context of the phenomenon as part of the study. Also, interpretive researchers study people rather than objects (Meredith et al., 1989), as in this dissertation.

The *natural/artificial* dimensions (X-axis of Figure 1-4) concern the source and kind of information used in the study. The *natural* end of the continuum is empiricism that derives conclusions from concrete, objective data. The *artificial* end is subjectivism that is characterized by deriving explanation from interpretation and artificial reconstruction of the reality (Meredith et al., 1989). The researcher’s perception of the reality is formed by the mechanisms used to observe it. These mechanisms can be classified into *direct observation*, *people’s perceptions*, and *artificial reconstruction*. In the case of *direct observation*, the researcher observes the phenomenon by himself, e.g., through field studies and field experiments. These cases assume that the phenomenon can be detected by human senses as “objective reality.” If the researcher collects the data through “somebody else’s eyes,” e.g., with surveys and interviews, he assumes the *people’s perceptions* of the objective reality. Lastly, *artificial reconstruction* refers to recreation or simulation of the objective reality. Classical examples are conceptual modeling, simulations, or artificial experimentation (Meredith et al., 1989).

FIGURE 1-4: CLASSIFICATION OF THE PAPERS ACCORDING TO MEREDITH ET AL.’S FRAMEWORK⁷



As shown in Figure 1-4, the three papers can be classified into three different cells to accomplish a multi-dimensional and multi-method approach to study people managing supply chains. Paper 1 and Paper 3 adopt the knowledge generation approach of an *empiricist*. Hereby the papers rely on different sources and kinds of information. On the one hand, in Paper 1, we use survey methods to observe people’s perceptions on the research topic. The paper qualifies as theory *testing* research according to Meredith et al. (1989). Paper 3, on the other hand, leverages *artificial* data derived from an online experiment that recreates a real-life situation to *explain* employee selection in SCM. Paper 2 analyzes and *describes* the careers of supply chain executives. The assumed knowledge generation approach has a more *interpretive* character than Papers 1 and 3. In fact, the

⁷ Adopted from Meredith et al. (1989), p. 309.

information used is self-reported (*people's perceptions*) professional resumes. These can be regarded as historical data of professional career paths, beginning with the secondary education and ending with the current job position at the time of the data collection. However, as CVs also fulfill the criteria of empirical (secondary) data one could argue that we also assume the *empiricist* perspective. In wise foresight, Meredith et al. (1989, p. 309) note that for such cases "methodologies logically could fall into a number of cells."

As a supplement to the philosophical classification above, a brief technical overview about the data types, sources, and collection approaches and analysis methodologies is provided in the following. Later, in the respective chapters, all methodological aspects will be described and explained in detail according to contemporary scientific standards.

For the first paper, in Chapter 2, an online survey with a multi-national sample of supply chain professionals was conducted. Thorough development of the questionnaire was ensured through application of pre-used measurement items from peer-reviewed journals after a comprehensive review of various literature streams, i.e., SCM/OM, logistics, strategic management, human resource management, training and education, organizational behavior, and psychology research. Invitations for survey participation were distributed by email to 1,465 supply chain professionals across Europe, most notably in Germany, Denmark, Austria, and Switzerland. A total of 336 initial responses were collected. In order to facilitate high answer precision and accuracy, we included a gate-keeper question in the questionnaire that aimed to separate knowledgeable from unknowledgeable respondents. As a consequence, 63 respondents who could not confirm their knowledge of their firm's SCM and HRM activities were eliminated from the final sample. Thus, 273 responses qualified for the empirical analysis, which corresponds to an effective response rate of 18.8%, in line with similar studies (van der Vaart & van Donk, 2008). Convergent validity and reliability, discriminant validity and model fit were assessed using confirmatory factor analysis

(CFA). The potential methodological and data-related concerns of non-response bias, common method bias, and multicollinearity were removed after multiple inferential statistical tests, heuristics, and methodological remedies did not point toward any of those issues. Structural equation modeling (SEM) with maximum likelihood estimation was used to calculate regression weights for the direct effects of modeled relationships. For an advanced mediation analysis we used the bias-corrected bootstrapping approach with 5,000 iterations to estimate indirect effects between constructs.

For the second paper (Chapter 3), 307 professional resumes of supply chain executives were collected from the social network for business professionals, XING, between October 2012 and March 2013. A user profile on XING consists of a full resume (CV), including any relevant information about professional career and educational background. Those resumes were then coded as a sequence to apply optimal matching analysis (OMA), a sequence analysis method originating from comparison of DNA strands used to analyze genealogic trees of species. Subsequently, hierarchical cluster analysis with Ward's method was used to group similar career paths to clusters that resembled patterns among the biographies. The combination of OMA and cluster analysis has been used as a premier research methodology in sociology to study life courses or careers for decades and has been continually developed further (Vinkenburg & Weber, 2012). As a bonus, its application in the underlying dissertation serves as an introduction of this method to the SCM research community. Hopefully, it paves the way for future application in SCM research to tackle contemporary research gaps as demanded by fellow scholars, (e.g., Sanders & Wagner, 2011). Despite its premier employment for career and life course studies, OMA is theoretically applicable to any kind of sequential data. Hereby, it goes beyond traditional regression analysis that treats its variables as independent. OMA, on the other hand, treats sequences consisting of a number of elements (variables) as entire trajectories that are intrinsically

linked (Abbott & Forrest, 1986). This method takes a distinguished analysis approach that uncovers relationships beyond most regression analyses (Vinkenburg & Weber, 2012; Chan, 1995).

TABLE 1-2: OVERVIEW OF RESEARCH METHODOLOGIES AND DATA

Chapter	Data type	Data source	Data collection method	Stage of research cycle ⁸	Sample size (n)	Analysis methodologies
2	Primary data: Survey responses (Likert-scaled)	European SCM (-related) professionals	Online survey	Testing	273	<ul style="list-style-type: none"> ▪ Confirmatory factor analysis (CFA) ▪ Structural equation modeling (SEM) ▪ Bootstrapping mediation analysis
3	Secondary data: Professional CVs (Sequence data)	www.XING.de	Screening & download of CVs	Description	307	<ul style="list-style-type: none"> ▪ Optimal matching analysis (OMA) ▪ Hierarchical cluster analysis
4	Primary data: Preference indications (based on experimental trade-off decisions)	European SCM (-related) professionals	Online adaptive choice-based conjoint (ACBC) experiment	Explanation	243	<ul style="list-style-type: none"> ▪ Hierarchical Bayes (HB) estimation ▪ Cluster and ensemble analysis (CCEA)

For the third paper (Chapter 4) I conducted an adaptive choice-based conjoint (ACBC) analysis with 243 European managers from April to June 2016. ACBC analysis is one of the newest developments of the traditional conjoint analysis, which is one of the most applied and reputed marketing research techniques (Green, Krieger & Wind, 2001). “Conjoint” is a composite term of “considered *jointly*” because respondents indicate their preferences toward a set of attributes while

⁸ According to Meredith et al. (1989).

considering them jointly (Green & Rao, 1971). As a result, this approach captures complicated trade-offs, in which participants have to make decisions under real-life constraints (Wind et al., 1989). More technical, hierarchical Bayes (HB) estimation is used to estimate the individual utility functions and, beyond that, the partial-utility functions of each attribute for all participants. In this study, respondents are asked to trade-off between hypothetical job candidates based on six competency attributes. The ACBC research approach distinguishes this study from previous papers that used conventional questionnaires in two ways: First, its trade-off design enables me to estimate the relative importance of competencies rather than surveying questionnaire items independently from each other (absolute importance). Second, by capturing the respondents' individual preferences, I am able to segment all participants based on convergent cluster and ensemble analysis (CCEA) into different groups. That technique reveals different types of managers that make hiring decisions in SCM, further extending the knowledge on SCM decision-makers.

2 Individual Competencies, Organizational Knowledge, and SCM Performance

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Abstract

The impact of knowledge on supply chain management (SCM) has been well researched. However, there is little research distinguishing between competencies/individual knowledge and organizational knowledge on more finely nuanced levels. Our research aims to differentiate between these two types of knowledge for SCM in order to acquire practical and theoretical insights into how SCM performance is created. Drawing on the theory of the knowledge-based view (KBV), we use an integrated model to hypothesize and test the impact of individual SCM competencies and organizational SCM knowledge on SCM and financial performance. We achieve our results using structural equation modeling and bootstrapping mediation analysis based on a multi-national survey sample. The findings reveal that individual SCM competencies and organizational SCM knowledge positively influence SCM performance to a similar magnitude. Organizational learning enhances individual competencies and organizational knowledge significantly and equally, but corporate training programs for developing individual competencies fall surprisingly short of expectations. The results highlight organizational learning's strong indirect effect on SCM performance through competencies and knowledge, extending the insights of previous studies that primarily addressed learning's direct contribution to performance.

Keywords: Knowledge-based View, Organizational Learning, SCM Competencies, Human Resources, SCM Performance, Survey, Structural Equation Modeling

2.1 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, Grosse-Ruyken & Erhun, 2012). Recent SCM research has adopted the knowledge-based view (KBV) to investigate the impact of knowledge on supply chain and company performance (Hult, Ketchen Jr. & Slater, 2004; Craighead, Hult & Ketchen Jr., 2009). Studies like these frequently focus on the impact of organizational knowledge rather than on the competencies of individuals. Most often, both components are aggregated into one concept (Ellinger et al., 2011; Hult et al., 2006). However, classical knowledge management research finds distinctions between the two dimensions (Felin & Hesterly, 2007).

The oversimplification of knowledge and competencies in the recent SCM literature stream is problematic, since it fails to capture the true locus of the knowledge involved in value creation (Felin & Hesterly, 2007). In other words, there is an ongoing debate about the extent to which value is created. Within this divergence among knowledge management scholars, the majority holds the view that company-level knowledge is the locus of value creation (e.g., Kogut & Zander, 1992; Eisenhardt & Martin, 2000). The advocates of the individual level are in the minority (e.g., Simon, 1991; Grant, 1996). This distribution has been challenged, keeping the debate open. The separate contribution of individual competencies vs. organizational knowledge has not been investigated in SCM specifically. So far, only Schoenherr, Griffith and Chandra (2014) have studied knowledge management on a more finely nuanced level by distinguishing between tacit and explicit knowledge in supply chains. They find 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 can be defined as “knowledge beyond the aggregation of individual knowledge” (Nahapiet & Ghoshal, 1998). Other researchers have conceptualized it as the knowledge stored in databases, routines, processes, documentations, manuals and machines (Felin & Hesterly, 2007). In general, it is easily codified and shared with others at practically zero marginal cost. There is a certain overlap to the principle of “explicit” knowledge found in KBV. Explicit knowledge can be readily articulated, codified, accessed and verbalized (Hélie & 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 that are related to high on-the-job performance on an individual level (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 their development affect a company’s SCM performance (McAfee, Glassmann & Honeycutt, 2002). However, academic research has rarely addressed the link between HRM and SCM (Hohenstein, Feisel & Hartmann, 2014). Similarly, practitioners have largely neglected HRM and its impact on SCM (Ellinger & Ellinger, 2014; 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 primary purpose of this paper is to extend the understanding of SCM competencies as being knowledge based, and consequently splitting SCM knowledge into its individual and organizational components. This disentanglement renders HRM’s contribution to SCM visible by revealing the impact of HRM tools on SCM competencies. The second objective is to uncover their antecedents and impact on company performance, thus developing a comprehensive model

of value creation by developing SCM competencies. We approach these objectives as follows: we first investigate and quantify the relationships of individual SCM competencies and organizational SCM knowledge as focal constructs to SCM and financial performance. Next, we analyze the impact of organizational learning and corporate training as the antecedents of individual competencies and organizational knowledge.

We tested our hypotheses using structural equation modeling (SEM) with maximum likelihood estimation on the basis of survey data collected from 273 supply chain professionals from companies based in Europe; most notably, in Germany, Denmark, Switzerland and Austria.

The rest of this paper is structured as follows: Section 2.2 presents the theoretical basis and development of the hypotheses, Section 2.3 outlines the research design and the methodological approach, Section 2.4 summarizes the results of our analysis, Section 2.5 discusses the findings and Section 2.6 summarizes the theoretical and managerial implications and concludes the paper.

2.2 Theoretical Basis and Hypotheses

The overarching premise of our research is that close collaboration between SCM and HRM can positively influence a company's SCM performance through knowledge and employee development management. We integrated the HRM and SCM literature that shares a theoretical foundation into a company's KBV and empirically tested the hypotheses.

2.2.1 Human Resource Management in SCM

Numerous studies in the management literature show the positive impact of HRM on a variety of performance outcomes. For example, Aguinis and Kraiger (2009, p. 459) show that training enhances recipients' declarative, procedural and strategic knowledge, and they find 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 – several scholars have called for more research on HRM issues in SCM (Fisher et al., 2010; Cottrill & Rice Jr., 2012). The compelling logic of KBV conceptualizes the motivation for employing and developing highly competent personnel. Drawing on the KBV's foundations in the resource-based view capable individuals can establish a competitive advantage if their competencies are valuable, rare, inimitable and non-substitutable (VRIN criteria) (Wernerfelt, 1984; Barney, 1991; Grant, 1996). These criteria should hold especially true for supply chain personnel, as research and anecdotal reference have consistently suggested that they need to possess unique competencies that differentiate them from other managerial staff and make them valuable. Numerous studies also suggest the value of specific areas of competency (Hohenstein, Feisel & Hartmann, 2014). There is also widespread agreement among researchers and managers that the ongoing, acute shortage of qualified supply chain personnel makes them – by definition – rare (Cottrill, 2010; John, 2015). SCM has recently evolved towards a more strategic role, suggesting that employees who adapt to rapid development have made themselves highly inimitable. Today's SCM talents need to possess different competencies than before (Richey, Tokman & Wheeler, 2006; Sweeney, 2013) because the demands on supply chain managers have changed (Harvey & Richey, 2001; Scott et al., 2015). Since intangible abilities such as adaptability are difficult to train and develop, competitors can be expected to struggle as they seek to replicate this highly qualified staff. And despite recent technological advancements and automation in supply chains, qualified SCM staff is non-substitutable. In fact, advancements have made qualified staff even more essential, since employees need sophisticated education to manage high tech systems. In sum, qualified SCM personnel can be expected to fulfill the VRIN criteria and contribute to a company's competitive advantage.

The above-mentioned studies and others have compiled a long list of items that reflect the multifaceted requirements of supply chain personnel on a granular level. They can be assigned to

three broader competency categories developed by Gammelgaard and Larson (2001), who use exploratory factor analysis to classify the range of competency requirements for supply chain managers into “managerial/interpersonal,” “quantitative/technical” and “SCM core” skills. For practical reasons, this study uses this classification to cover the multidimensional SCM competencies on an aggregated level. The measurement instruments for these and other constructs will be discussed in detail in Section 2.3.2. One of HRM’s main activities is to develop employee competencies by designing and implementing adequate training and continuing education programs that facilitate change at the individual and organizational levels (Vidal-Salazar, Cordón-Pozo & Ferrón-Vilchez, 2012). In accordance with KBV, Lawler (1994, p. 7) proposes 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 ones their strategies require (Vidal-Salazar, Cordón-Pozo & Ferrón-Vilchez, 2012) and deploy personnel flexibly in an environment of changing activities. Moreover, employees are only able to contribute critical capabilities to their teams if their employer has developed their individual skills further (Lawler, 1994). Several papers find that HRM activities – which include training – have a positive effect on a variety of SCM performance dimensions, particularly quality metrics (Jayaram, Dröge & Vickery, 1999; Ahmad & Schroeder, 2003). Competency development is essential for many management roles, but it is vital for supply chain managers in particular. 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 two hypotheses:

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

H2: *Individual SCM competencies are positively related to SCM performance.*

2.2.2 Knowledge Management in SCM

Previous studies show that knowledge can be a strategic resource in supply chain management. Hult et al. (2006) investigate why some supply chains perform better than others. They find that the degree to which strategy and organizational knowledge elements mesh has a direct impact on supply chain performance. Previously, Hult, Ketchen Jr. & Slater, (2004) investigated the impact of knowledge management on cycle time in strategic supply chains, finding that the knowledge development process can explain substantial variance. Hult, Ketchen Jr. & Arrfelt (2007) count knowledge development among the levers for improving strategic supply chain management. Overall, the authors concur that knowledge is a valuable, rare, inimitable and non-substitutable resource in SCM that results in competitive advantage. Recently, Schoenherr, Griffith and Chandra (2014) have empirically shown 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 under consideration of the individual SCM competencies and antecedent factors discussed in the following section.

H3: Organizational SCM knowledge is positively related to SCM performance.

The literature indicates that learning capability is an important factor in company success (Leonard-Barton, 1992; DiBella, Nevis & Gould, 1996). A corporate learning culture/atmosphere facilitated by the top management and HRM practices is often the seedbed of organizational learning capability. Hult, Ketchen Jr. & Nichols Jr. (2003) discuss the potential role of organizational learning as a strategic resource in supply chains. They find that organizational learning has a positive, direct effect on a set of learning, supply management, management and performance consequences. 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. Individuals and organizational entities communicate and make crucial decisions (e.g. as determining order quantities and production schedules) by exchanging information. Various authors concur that information is the basic input for organizational knowledge (Kogut & Zander, 1992; Davenport & Prusak, 1998). In fact, knowledge can be regarded as “the processing of ready-made information” (Nass, 1994, p. 39). Based on the management literature, our assumption is that organizational learning must first be linked to organizational knowledge and competencies and then converted into performance. Because common sense says that information and knowledge are quite similar, 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” and “information becomes knowledge when it is processed by the actor” (Flores et al., 2010, p. 645). Information is upstream to knowledge. The organizational sub-processes of learning can be linked to organizational knowledge and competencies because shared information lays the foundation for developing into knowledge and competency. In line with the above argumentation, we propose the following hypotheses:

H4: Organizational learning is positively related to organizational SCM knowledge.

H5: Organizational learning is positively related to individual SCM competencies.

2.2.3 Direct Effects on Financial Performance

Many papers have shown both the positive and negative financial effects of SCM practices on companies. On one hand, the research shows that underperforming SCM and supply chain disruptions have significant effects on shareholder value and accounting results. Supply chain glitch announcements, for instance, are associated with an average short-term abnormal decrease

in shareholder value of 10.28%, while excess inventory announcements trigger a stock market reaction ranging from -6.79% to -6.93% (Hendricks & Singhal, 2003, 2009). On the other hand, companies also experience the positive financial effects of superior SCM practices. Ellinger et al. (2011) show that companies that are highly ranked on AMR Research's "Top 25 Supply Chain" list have significantly higher Altman Z scores than their peers⁹. Multiple survey-based papers show that the implementation of lean or just-in-time practices, both classical SCM tools, has a positive effect on several company financial measures: profitability, ROA, cash flow margin and total cost (Fullerton, McWatters & Fawson, 2003; Callen, Fader & Krinsky, 2000). In line with the previous literature, we hypothesize the following:

H6: *SCM performance is positively related to company financial performance.*

2.2.4 Indirect Effects on SCM Performance

Malhotra et al. (2014) and Rungtusanatham, Miller & Boyer (2014) report that mediation analysis is a useful technique for deriving more robust, 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. Hult (1998) and Hult, Ketchen Jr. & Nichols Jr., (2003) show that organizational learning can be a strategic resource, since it positively affects multiple aspects of supply management that include the organization's cycle time and overall performance. These studies do not incorporate potential mediators between organizational learning and performance measures. Hult (1998) investigates the effect of

⁹ Altman Z scores are a comprehensive measure of a company's financial health.

organizational learning on purchasing information processing, which subsequently affects subjective and objective cycle time. Although information processing is a mediator, the study does not analyze the indirect effects of organizational learning on cycle time. Tippins and Sohi (2003) show 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 to organizational learning as mediating factor with indirect effects on performance is surprising. As elaborated in Section 2.2.2, organizational learning has been identified as 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, mediated by individual competencies and organizational knowledge components modeled as focal constructs.

***H7a:** The relationship between organizational learning and SCM performance is mediated by individual SCM competencies.*

***H7b:** The relationship between organizational learning and SCM performance is mediated by organizational SCM knowledge.*

In line with previous argumentation, we can also expect indirect corporate training effects on SCM performance. The large share of HRM literature that has focused on training suggests its positive effects on competency and capability development, as elaborated in Section 2.2.1. Furthermore, Aguinis and Kraiger (2009) show 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.

Based on the previous arguments, we propose the hypothesis:

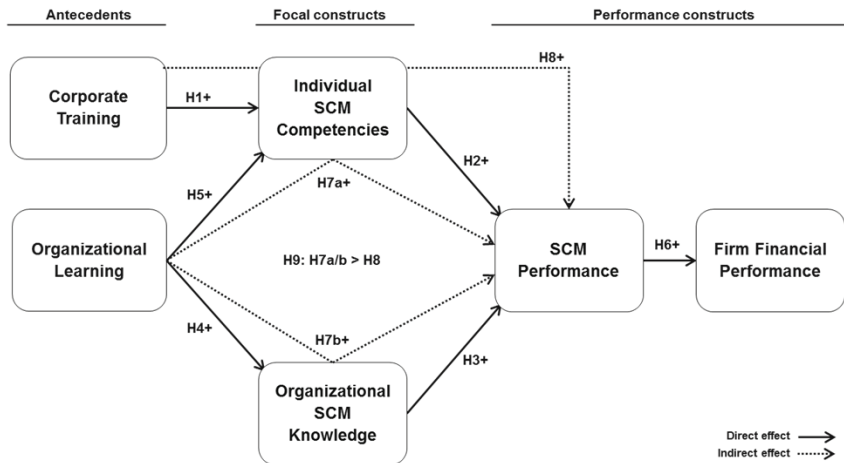
H8: *The relationship between corporate training and SCM performance is mediated by individual SCM competencies.*

However, there are studies suggesting 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 (Ellinger & Ellinger, 2014). Consistent with this observation, Ellinger et al. (2008) find a significant positive contribution of formal training to employee-level performance indicators, but it falls short of affecting the organization's bottom-line performance in logistics service provider companies. 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 it is also an enabler that creates knowledge in the first place (Hult et al., 2000; Hult, Ketchen Jr. & Nichols Jr., 2003). We therefore expect the positive contributions of organizational learning to be translated into actual performance mediated by individual SCM competencies and organizational knowledge. Since previous studies have observed a strong link between organizational learning and performance more often than one between training and development activities, we expect organizational learning's indirect effect to be stronger.

H9: *The relative indirect effects of organizational learning on SCM performance are stronger than the relative indirect effects of corporate training.*

Figure 2-1 provides an overview of the conceptual model with all the hypothesized relationships we stated above.

FIGURE 2-1: CONCEPTUAL MODEL WITH HYPOTHESIZED RELATIONSHIPS



2.3 Research Design and Methodology

2.3.1 Questionnaire Development and Pre-testing

All of our constructs are latent variables that must 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 relationship between constructs with a structural path model. To ensure the reliability and validity of the measurements, we scanned the management literature for previously employed multi-item measurement scales. The complete questionnaire with references is included as Appendix 2-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.

The final questionnaire was translated from English into German and Danish because we wanted to give the respondents the opportunity to answer the survey in their native language. Respondents tend to answer more truthfully and are more comfortable with giving extreme answers in their native language (Gibbons, Zellner & Rudek, 1999). According to good academic practice and in line with other studies in our field, we used “back-and-forth” translations to neutralize the risk of mistranslation. The following section describes the sources and development of the measurement scales used.

2.3.2 Measurement Instruments

Except for SCM performance, which we measured quasi-perceptually, we used perceptual measurement items as our survey instrument. We carefully selected all the measures we used and adopted or adapted them from previous papers after a rigorous literature review that identified the following scales as best fit for the study’s purposes.

The “individual SCM competencies” construct is based on the previous work of Gammelgaard and Larson (2001), who identify three categories of relevant supply chain and logistics manager competencies. Accordingly, we called the sub-categories of the construct “managerial competency,” “SCM core competency” and “IT competency.” The phrasing and logic of the items were adopted from Byrd and Turner (2001), who assess skill requirements and their impact on IT personnel. We adopted three first-order constructs by Hult et al. (2006) – “accessibility of knowledge,” “knowledge intensity” and “knowledge use” – to measure “organizational knowledge” as a multi-dimensional second-order construct. They cover different aspects of organizational knowledge. We adopted and modified items from Ahmad and Schroeder (2003) and Ahire, Golhar and Waller (1996) to measure the company’s “corporate training” efforts. The items are related to budget and resource allocation for training programs and HRM support for employee training. Measurements used by Flores et al. (2010) were adapted to design the second-

order construct for “organizational learning” with the three first-order constructs of “information acquisition,” “information distribution” and “information absorption.” The literature provides many different constructs for measuring SCM performance. In this study, we use a combination of items previously applied by Rexhausen, Pibernik and Kaiser (2012) and Fawcett and Waller (2013). We use six quasi-perceptual measurement items that compare the focal company’s performance with its top competitors in terms of supply chain cost, quality, responsiveness, innovation, improvement and overall performance. By employing six items, we measure this important endogenous factor broadly, reflecting the many different facets of SCM. Four items developed by Carr and Pearson (1999) were employed to measure “firm financial performance:” the respondents were asked to indicate whether their return on investment (ROI), profits as percentage of sales, earnings before interest and taxes (EBIT), and the market value of the company increased or decreased over the past three years. Carr and Pearson (1999) compared these measures with objective (secondary) firm financial performance data and found the measures to be reliable.

2.3.3 Control Variables

To avoid omitting variables that could affect our endogenous variables, we included industry affiliation, company size in revenue and country in the model as control variables. They are all measured in categorical values and are among the mandatory demographic questions. They are coded as binary variables and included in the structural model.

2.3.4 Data Sample and Collection Procedure

To examine our hypotheses, we used two European university databases 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. Fourteen days after the initial invitation, we sent out a friendly reminder to participate in the survey. As an incentive to

participate, we promised to support a charity organization by funding measles vaccinations for children in developing countries for every questionnaire that was returned and 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, thus ensuring reliable data quality. We asked their level of agreement with the statement: “I am knowledgeable about my company's SCM, i.e., about its activities and responsibilities in the organization, overall performance indicators and the employee training programs in place.” The 64 respondents who could not confirm this statement were eliminated, leaving 273 usable responses in our final sample. These numbers translate to an effective response rate of 18.8%, in line with comparable studies (van der Vaart & van Donk, 2008). Table 2-1 provides the descriptive statistics for our sample. The majority of respondents (76.2%) came from German-speaking countries (Germany, Austria and Switzerland), followed by Denmark (18.3%). A majority (65.2%) stated that they work in the SCM function of their companies (and therefore belong to our target group). 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 at the same time they are not too senior to have limited exposure to daily workflows. A total of 63.4% have personnel responsibilities and should therefore be interested in competency development and other HRM activities within their companies. At the same time, a large share had reasonable levels of business experience (cumulated, 61.9% over 10 years) and company experience (cumulated, 53.8% over 5 years), indicating that they are reliable sources.

To account for potential non-response bias, the means of all responses of the earliest 30 respondents and latest 30 respondents were compared using a Mann-Witney U test (Lambert & Harrington, 1990; Wagner & Kemmerling, 2010). The latest 30 respondents served as a proxy for

non-responding managers (Armstrong & Overton, 1977). We did not find any statistically significant differences for $p < 0.05$. A comparison of two descriptive variables (company revenues and number of employees) of the 30 earliest and latest respondents did not show a statistically significant difference either. We concluded that non-response bias is not a serious concern in our data.

TABLE 2-1: DESCRIPTIVE SAMPLE STATISTICS

	n	%		n	%		n	%				
Automotive & Parts	34	12.5%	Company revenue (in Euros)			Business experience (in years)						
Chemicals	28	10.3%					Less than 2	12	4.4%			
Construction & Materials	10	3.7%					2-5	40	14.7%			
Food & Beverages	23	8.4%					>5-10	52	19.0%			
Healthcare	36	13.2%					>10-25	144	52.7%			
Industrial Goods & Services	49	17.9%	Above 10 bn	98	35.9%	More than 25	25	9.2%				
Oil & Gas	5	1.8%	Hierarchical level			Company experience						
Personal & Household Goods	11	4.0%					less than 2	46	16.8%			
Retail	26	9.5%					2-5	80	29.3%			
Technology	32	11.7%					>5-10	70	25.6%			
Telecommunication	7	2.6%					>10-25	67	24.5%			
Utilities	5	1.8%	No management responsibility	64	23.4%	More than 25	10	3.7%				
Others	7	2.6%	Department			Country						
Total	273	100%					SCM	178	65.2%	Austria	13	4.8%
							Logistics	26	9.5%	Denmark	50	18.3%
							Procurement/Sourcing	31	11.4%	Germany	145	53.1%
							Production/Manufacturing	8	2.9%	Switzerland	22	8.1%
			Other	30	11.0%	Other	43	15.8%				

2.3.5 Common Method Bias

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). Ketokivi and Schroeder (2004) show that it is impossible to rule out CMB entirely in a research setting such as ours. However, there are multiple remedies that can at least detect an underlying CMB and estimate the magnitude of it.

Following two remedy techniques by Lindell and Whitney (2001) and Podsakoff et al. (2003), we applied statistical techniques to assess the magnitude of CMB. As a first statistical remedy, we pursued an a priori strategy. We installed a marker variable in the questionnaire that is theoretically unrelated to all other variables in the model (Lindell & Whitney, 2001). We chose a question item that is related to SCM in general but unrelated to our specific research question in order to have it covered by focal items. Respondents were asked to agree or disagree on a 7-point Likert scale to the statement, “we retain buffer inventory of parts and finished goods”, a question related to the strategic supply chain priorities of a firm (Fisher, 1997; Wagner, Grosse-Ruyken & Erhun, 2012). Because there is not “one size fits all solution” (Wagner, Grosse-Ruyken & Erhun, 2012) and, hence, disagreement and agreement to this statement depends on product characteristics, industry affiliation and company demographics, among other factors, this variable should be unrelated to the focal variables in the model. A two-tailed significant test on Pearson’s correlation coefficients between the marker variable and 41 variables were calculated. Correlations ranged from -0.037 to 0.134. In fact, we found only two weak statistically significant correlations on items belonging to two different constructs (SCMP2: 0.134, $p = 0.026$; CIT1: 0.121, $p = 0.045$; see Appendix 2-A for further information on item level) in our model, suggesting that there should not be a strong effect of CMB in our dataset. Second, we complemented the a priori CMB assessment with an ex post technique by installing a common latent factor (CLF) that loaded on all items into our measurement model (CFA) (e.g., Paulraj, Lado & Chen, 2008; Flynn, Huo & Zhao, 2010). Regression weights and their p-values in the CLF model were compared to the original measurement model (Podsakoff et al., 2003). The CLF did not change the significant levels of factor loadings, nor did any standardized regression weight (SRW) deviate by more than

0.1 between both models.¹⁰ In conclusion, although the presence of CMB cannot be ruled out entirely, at least, we cannot detect an interfering presence.

2.3.6 The Measurement Model

Estimation method: For our main analysis, we used the covariance-based software IBM Amos 22 with maximum likelihood (ML) estimation. ML estimation has been deemed to be a fitting choice for theory-testing research settings such as ours (Kline, 2011), and the use of an estimation method other than ML requires explicit justification (Hoyle, 2000). ML estimates in large samples were asymptotically unbiased, consistent, and efficient when all statistical requirements were met (Kline, 2011): A minimum of 200 observations, normally distributed data, reflective measures, and a minimum of 3 items per construct (Tabachnick & Fidell, 2007; Kline, 2011). Our variables were measured on a discrete Likert scale that cannot satisfy the assumption of continuous, normally distributed observations by definition (Curran, West & Finch, 1996). To investigate further whether ML estimation is appropriate in our case, we assessed the stability of parameter estimates across estimation methods by performing a second CFA with generalized least squares (GLS) in addition to the CFA with ML (Ketokivi & Schroeder, 2004). Subsequently, we compared regression weights between the ML and GLS models, which showed no concerning deviations. In fact, regression weights deviated by only 1.66% on average. Because estimates appear to be robust across estimation methods and because ML is usually capable of accommodating data that slightly deviate from normal distribution (Hu & Bentler, 1999), we continued using the ML estimation in our analysis.

¹⁰ Note: Our data also passed the “Harmon’s single factor test with CFA setting”, a procedure that is commonly reported in SEM-based papers. However, as there is strong evidence that this method is not very meaningful (Podsakoff et al., 2003), we forego a discussion of this procedure in the paper.

Convergent validity and reliability: CFA was used to test the reliability and validity of our constructs. All measured constructs yielded high values of Cronbach's alpha (average = 0.848, [0.746; 0.927]) and composite reliability (CR, average = 0.856, [0.768; 0.928]) exceeding recommended thresholds in the literature (Cronbach, 1951; Hair et al., 2010). Thus, both measures indicated construct reliability. Convergent validity was also positively assessed: Standardized factor loadings were all greater than 0.5 [0.552; 0.989], with the average being 0.798, and all loadings were statistically highly significant at $p < 0.001$, pointing towards convergent validity (Vickery et al., 2003; Dröge, Jayaram & Vickery, 2004; Narasimhan & Kim, 2002). Two further heuristic approaches provided further indications of convergent validity: All estimates were at least twice as large as their standard errors (Anderson & Gerbing, 1988), and average variance extracted (AVE) was above 0.5 for all constructs (Fornell & Larcker, 1981). A summary is displayed in Table 2-2. Summary data on the item level are shown in Appendix 2-A.

Discriminant validity: We used the inferential χ^2 -difference test (a.k.a. constrained phi test) complemented by a heuristic assessment to evaluate discriminant validity. We built a constrained CFA model for every possible pair of constructs, in which the correlations between the paired constructs were fixed to 1.0. This model was compared with the original unconstrained model in which the correlations among constructs were freely estimated, with the expectation that the unconstrained model fit the data significantly better than the model constrained to unity (Bagozzi & Phillips, 1982). Because a sequential repetition of the χ^2 -difference test increases the risk of type I error, we used adjusted p-values to determine a 5% significance level (Anderson & Gerbing, 1988). Our CFA included six main constructs. Therefore, the p-values of the 15 possible constrained models versus the unconstrained models must be below 0.0033 to achieve a 5% significance level (Voorhees et al., 2016). Out of the 15 possible inferential χ^2 -difference tests, the unconstrained modeled passed the test 12 times, failed it marginally twice

($p = 0.022$ and 0.035) and significantly once ($p = 0.176$). The latter problematic correlations existed between the corporate training and the second-order-construct individual SCM competencies. However, as the statistical test determined that constructs cannot be discriminated, a theoretical content-based evaluation of the respective question items should rule out a problematic overlap between them. The items address very different topics and, thus, should not measure the same latent variables accidentally. The high correlations between organizational learning which reflect three facets of handling information and organizational SCM knowledge / individual SCM competencies were expected as distinctions between information and knowledge in general remains blurry in the literature (Bell, 1999; Paiva, Roth & Fensterseifer, 2008). Yet, they are statistically discriminated by the inferential χ^2 -difference tests which indicates that respondents had no issues with distinction between both topics. For further testing of discriminant validity, we calculated the 95% confidence intervals (CI) of the inter-construct correlations. According to Anderson and Gerbing (1988), discriminant validity is achieved if the CI does not include a correlation of 1.0. No 95% CI included a correlation of 1.0 in our model. Heuristic-based approaches pointed in the same direction: First, the square root of the AVEs in each case was greater than the corresponding correlation between latent variables (Fornell & Larcker, 1981). Second, maximum shared variance (MSV) and average shared variance (ASV) for all focal constructs were smaller than the corresponding AVE (Hair et al. 2010). Hence, we are confident that discriminant validity is achieved on an acceptable level. Discriminant validity measures are shown in Table 2-3.

Model fit: There is no established consensus in the literature regarding what constitutes acceptable model fit (Iacobucci, 2010; Kline, 2011; Gerbing & Anderson, 1992). In fact, there are many different suggested model fit parameters, statistical tests, heuristics, cut-off values, and rules-of-thumb in the literature. We used a mix of global and incremental model fit indices, i.e., model- χ^2

with adjusted p-value determined by Bollen-Stine bootstrap (1990), and Fornell and Larcker (1981) to assess model fit from multiple perspectives. The model- χ^2 is = 1192.528, $df = 755$. In order to diminish the impact of non-normally distributed observations on the model- χ^2 , we calculated the adjusted p-value of the model- χ^2 -value by performing the Bollen-Stine bootstrapping approach ($n = 5,000$ iterations) (Bollen & Stine, 1990). The p-value obtained is = 0.028 – we therefore have to reject the exact model fit hypothesis marginally. However, one has to be careful with quick judgment. As Kline (2011) notes, if χ^2 had not been statistically significant, “then the only thing that can be concluded is that the model is consistent with the covariance data, but whether the model is actually correct is unknown” (p. 200), and “closer to fit does not mean closer to truth” (p. 201). Moreover, the exact-fit hypothesis may be implausible in many applications of SEM (Steiger, 2007). As second model fit assessment, multiple heuristic measures were used: Bentler’s comparative fit index (CFI), Bollen’s incremental fit index (IFI), the Tucker-Lewis-index (TLI), and the root mean square error of approximation (RMSEA) with “p of close fit” measure (PCLOSE). CFI, IFI and TLI are goodness-of-fit indicators that are evaluated for their closeness to 1.0. CFI values close to 0.95 (Hu & Bentler, 1999) and IFI/TLI values over 0.90 (Bollen, 1989) are desirable. The RMSEA is a badness-of-fit index, meaning that closeness to 0.0 is favorable. Usually, values close to 0.06 are considered to indicate good fit (Hu & Bentler, 1999). A P-CLOSE value greater than 0.05 (i.e., non-significant) is desirable because one can conclude that the fit of the model is indeed close (Kline, 2011). Our measurement model yields a good fit, indicating that our model corresponds with the data: CFI = 0.940, IFI = 0.940, TLI = 0.935, RMSEA = 0.046 with P-CLOSE = 0.900. Overall, drawing a conclusion on our multi-level model fit assessment, we consider the model fit sufficient and acceptable to proceed with the analysis.

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

n = 273	Mean	SD	CR	Cronbach's Alpha	AVE	MSV	ASV
Organizational Learning (OL)	4.55	1.49	0.853		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 (CT)	4.12	1.69	0.881	0.880	0.649	0.475	0.255
SCM Performance (SCMP)	4.89	1.30	0.867	0.851	0.527	0.415	0.300
Firm Financial Performance (FFP)	4.98	1.29	0.928	0.927	0.764	0.127	0.080
Individual SCM Competencies (IC)	4.99	1.42	0.902		0.757	0.585	0.382
SCM core competency	4.88	1.39	0.792	0.791			
IT competency	4.64	1.48	0.885	0.882			
Managerial competency-	5.45	1.25	0.805	0.802			
Organizational SCM Knowledge (OK)	4.63	1.50	0.832		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 = 0.940, IFI = 0.940, TLI = 0.935, RMSEA = 0.046 with P-CLOSE = 0.900

TABLE 2-3: DISCRIMINANT VALIDITY: FACTOR CORRELATIONS WITH BOUNDS OF 95% CONFIDENCE INTERVALS

Constructs	OL	CT	SCMP	FFP	IC	OK
Organizational Learning (OL)	0.812					
Corporate Training (CT)	0.689 0.547-0.791 <i>0.022</i>	0.805				
SCM Performance (SCMP)	0.627 0.516-0.721	0.430 0.316-0.555	0.726			
Firm Financial Performance (FFP)	0.267 0.111-0.404	0.230 0.065-0.352	0.357 0.227-0.493	0.874		
Individual SCM Competencies (IC)	0.747 0.636-0.853	0.565 0.46-0.661 <i>0.176</i>	0.616 0.507-0.713	0.259 0.129-0.394	0.870	
Organizational SCM Knowledge (OK)	0.714 0.592-0.832	0.491 0.348-0.654	0.644 0.529-0.746	0.284 0.135-0.427	0.765 0.636-0.853 <i>0.035</i>	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 0.0033 (adjusted 5% significance level) and are not displayed in the table

2.4 Results

2.4.1 The Structural Model: Direct Effects

We used structural equation modeling to test our hypotheses regarding the relationships between our constructs. The structural model yielded an acceptable fit: CFI = 0.922, IFI = 0.923, TLI = 0.916, RMSEA = 0.052 with PCLOSE = 0.204 (Hu & Bentler, 1999; Iacobucci, 2010; Kline, 2011). The hypothesis test results are shown in Table 2-4 and Figure 2-2. None of the control variables (company size in revenue, industry and country) had a statistically significant effect on any of the endogenous constructs. However, we retained them in the model for completeness. H2, H3, H4, H5 and H6 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 (marginally) significant at the $p < 0.05$ level, the standardized regression weight (SRW) is very low (0.145), in particular in relation to organizational learning's effect on individual competencies (H5). According to Chin (1998), a low SRW can be considered insubstantial and of low theoretical value. Given the fact 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 = 0.780) and organizational knowledge (SRW = 0.811). This means that information acquisition, distribution and absorption are the crucial antecedents that facilitate high competency and organizational knowledge levels.

TABLE 2-4: RESULTS OF SEM: HYPOTHESIS TESTING

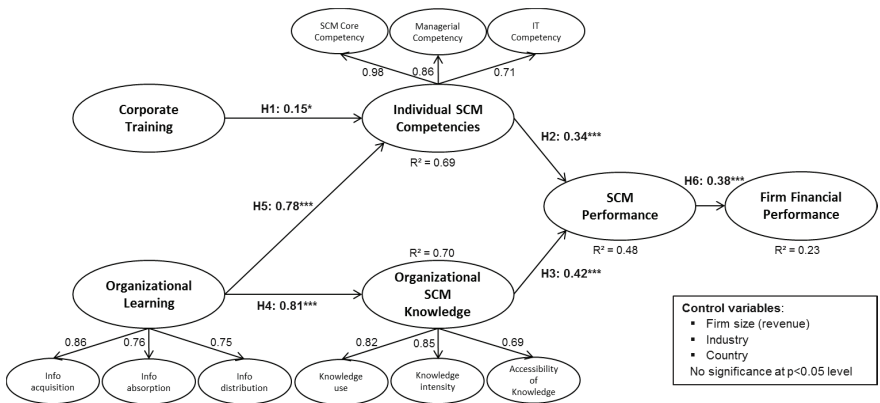
Direct relationships	Hypothesis	Support	Standardized regression weight (SRW)	t-values
Training → Competencies	H1	Partial	0.145	2.171*
Competencies → SCM Perf.	H2	Full	0.339	3.324***
Org. Learning → Competencies	H3	Full	0.780	7.828***
Org. Learning → Org. Knowledge	H4	Full	0.811	7.099***
Org. Knowledge → SCM Perf.	H5	Full	0.423	3.783***
SCM Perf → Firm Perf.	H6	Full	0.376	5.721***

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

Squared multiple correlations (R²) for endogenous constructs: Competencies = 0.69, Org. Knowledge = 0.70, SCM Perf. = 0.48, Firm Perf. = 0.23.

t-values from unstandardized solution

FIGURE 2-2: SEM MODEL WITH DIRECT EFFECTS



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

All estimates standardized

Model fit: CFI = 0.922, IFI = 0.923, TLI = 0.916, RMSEA = 0.052 with P-CLOSE = 0.204

Competencies (SRW = 0.339) and organizational knowledge (SRW = 0.423) positively influence SCM performance. More significantly, they do so at similar magnitudes. These findings are in line with previous studies on the effects of SCM knowledge (Hult et al., 2006; Hult, Ketchen Jr. & Arrfelt, 2007) and SCM competency (Ellinger et al., 2012) on various performance indicators.

As mentioned previously, these studies investigate a more aggregated level of knowledge, while we distinguish between individual and organizational factors. Confirming the previous results of multiple studies with various research settings and methodologies, we find a positive relationship ($SRW = 0.376$) between SCM and firm financial performance (Hendricks & Singhal, 2003; Hendricks & Singhal, 2009; Wagner, Grosse-Ruyken & Erhun, 2012). While this finding is not surprising, it confirms and emphasizes the significance and impact of SCM performance on multi-dimensional firm financial metrics that should be of interest to all stakeholders.

2.4.2 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 papers show the direct, positive effect of organizational learning on SCM and supply chain performance (Hult, 1998; Hult, Ketchen Jr., Nichols Jr., 2003). Furthermore, because organizational learning is related to information management, other studies have found empirical evidence that information absorption (Devaraj, Krajewski & Wei, 2007), processing (Hult, Ketchen Jr. & Slater, 2004) and sharing (Lee, Padmanabhan & Whang, 1997) have positive effects on supply chains. With the mediation analysis, we aim to shed further light on the indirect effects. We also investigate the indirect effect of corporate training on SCM performance while expecting it to be smaller (H9). In order to test the mediated effects, we applied the highly regarded bias-corrected bootstrapping approach (Malhotra et al., 2014). We generated a 95% bias-corrected confidence interval with 5,000 bootstrap iterations (Rungtusanatham, Miller & Boyer, 2014) to calculate the standardized indirect effects and their lower/upper limit values. Table 2-5 displays the results. The indirect effect of corporate training on SCM performance is almost negligible ($SRW = 0.049$) and of marginal significance (lower limit = 0.001; an indirect effect is considered to be insignificant if the 95% CI contains 0 (MacKinnon, Lockwood &

Williams, 2004). Therefore, we consider hypothesis H8 only partially supported. Organizational learning's indirect effect is relatively high (SRW = 0.608) and highly significant, fully supporting H7a and H7b. Since the mediated effect of organizational learning is considerably larger than that of corporate training, H9 is also supported. Moreover, mediation is almost evenly split between individual competencies and organizational knowledge.

TABLE 2-5: BOOTSTRAPPING MEDIATION ANALYSIS: INDIRECT EFFECTS

Indirect relationships	Indirect SRW	Bootstrapped 95% CI		Hypotheses
		Lower Bound	Upper Bound	
Mediated by Individual SCM Competencies				
Corporate Training → SCM Performance	0.049*	0.001	0.183	H8: Partially supported
Org. Learning → SCM Performance	0.264**	0.050	0.527	H7a: Supported
Mediated by Org. SCM Knowledge				
Org. Learning → SCM Performance	0.343**	0.095	0.631	H7b: Supported
Total Indirect Effects				
Corporate Training → SCM Performance	0.049*	0.001	0.183	H9: H7a/b > H8:
Org. Learning → SCM Performance	0.607**	0.492	0.704	Supported

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

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

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

2.4.3 Multicollinearity

As a robustness check, we test for the potential multicollinearity of factors that share a common dependent factor in the structural model. Multicollinearity is not desirable because the variance of independent factors overlap with each other and, thus, do not explain unique variance in the dependent factors (O'Brien, 2007). It also poses problems in theory-testing (type II errors) settings

(Grewal, Cote & Baumgartner, 2004). In our case, corporate training and organizational learning share the common dependent factor competencies. Competencies and organizational knowledge share the common dependent factor SCM performance. The literature on detecting multicollinearity in SEM is unclear, and multiple different approaches exist (Grewal, Cote & Baumgartner, 2004). We used the most common technique of calculating variance inflation factors (VIF) for all affected independent indicators using SPSS. Several rules of thumb exist about what cut-off values of VIF indicate multicollinearity. However, cut-off values are arbitrary if they do not consider several other factors, such as sample size, the magnitude of R^2 , the standard error of estimates, and reliability measures in the model and should therefore be neglected in rigorous research (Grewal, Cote & Baumgartner, 2004; O'Brien, 2007). Instead, emphasis should be placed on putting the interpretation of VIF into context. Four indicators reflect corporate training, and nine reflect the organizational learning first-order factors “information acquisition”, “information distribution” and “information absorption”. The highest measured VIF value was 4.6. All other VIF were below 3. We repeated this procedure for the indicators of competencies (9) and organizational knowledge (9). The maximum VIF was 3.6. Overall, those VIF values can be considered rather low (Hair et al., 2010). Multiple factors indicate that multicollinearity is not of major concern in this study. First, R^2 values of the dependent latent constructs – individual competencies and SCM performance – were 0.69 and 0.48, respectively, i.e., mediocre to high. Multicollinearity tends to be of greater concern when R^2 is relatively small (Mason & Perreault Jr., 1991). Second, the high average measurement reliability for the respective constructs (average CR = 0.856) supports high estimation accuracy, further mitigating the influence of multicollinearity on our analysis. In fact, measurement reliability is either the most important or second-most important determinant of estimate and standard error accuracy (Grewal, Cote & Baumgartner, 2004). Third, standard errors of estimates are rather low, as implied by the generally large t-values in Appendix 2-A. Only the acceptable but rather small sample size does not work

in our favor. In conclusion, the majority of factors indicate that multicollinearity is not a serious concern in our analysis.

2.5 Discussion and Contextualization

The empirical results statistically support all our theoretically developed hypotheses. However, the positive effect of corporate training is surprisingly limited and the explanations for this result should be investigated. The Council of Supply Chain Management Professionals (CSCMP) has conducted a related study on SCM talent development (Gibson, Goffnett & Williams, 2013). Our findings support many of its conclusions. First, the study highlights that the most popular current training methods are hands on: 76.2% of companies use “on-the-job functional training,” whereas approximately one-third work with certification from universities and professional organizations. Although the study traces positive trends and improvements in SCM training initiatives in practice, a need for more comprehensive training programs and methods that are capable of advancing the relevant competencies of SCM personnel remains (Gibson, Goffnett & Williams, 2013). The CSCMP study also shows that budget and time allocation for corporate training appears to be one source of poor training performance. There is considerable variability in spending and the number of training hours based on management levels. Although the median budget for SCM executive training is \$3,405 and averages 37.8 hours per year, the figures are \$1,000 and 30.4 hours per year for entry-level employees. This training gap is present despite the fact that new hires are heavily involved in daily workflows and operations that use high-end IT systems and SCM concepts. They are more likely to require in-depth training than executives who have years of experience and spend a large share of their time in meetings. Although some leading organizations have realized the importance of SCM training, most organizations still do not invest in training programs (Gibson, Goffnett & Williams, 2013).

The strong influence of organizational learning on competencies and organizational knowledge and the implied indirect effect on SCM performance should motivate companies to improve their information management and foster a learning mindset and environment in their companies. In their comprehensive paper on identifying sub-processes, Flores et al. (2010) provide interesting suggestions on the key prerequisites for organizational learning practices. They identify participative decision-making, organizational openness, learning orientation and transformational leadership as the crucial antecedents to one or more organizational learning sub-processes. Companies that strive to improve organizational learning can begin by facilitating these antecedent factors. For example, if organizations promote a high level of participative decision-making among their employees, the 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 usually provide an environment of information access and open communication that accepts debate and conflicts as a problem-solving approach, emphasizing information distribution and absorption. A fundamental, company-wide learning orientation is positively associated with information acquisition, distribution and absorption (Flores et al., 2010). Bass (1985) characterizes transformational leaders as charismatic individuals who develop the skills and abilities of subordinates, encourage innovative problem solving and provide guidance for achieving the organization's strategic goals. Specifically because they encourage open and honest communication and innovative thinking, challenge established beliefs and promote trust, transformational leaders facilitate the acquisition, distribution and absorption of information (Hult et al., 2000).

One of our goals was to split the broad term "knowledge" used in the literature into its individual and organizational facets. As intuitively expected, both dimensions contribute similarly to the

various SCM performance indicators. Companies certainly need to perform well on both levels. Many SCM activities and responsibilities rely and depend on organizational knowledge because they are process driven. SCM is charged with coordinating end-to-end physical, informational and financial flows inside the company and across boundaries with customers and suppliers (Cooper, Lambert & Pagh, 1997). Although SCM personnel must possess a comprehensive set of competencies (e.g., communication skills, decision-making skills, the ability to work in teams, the ability to lead negotiations and a customer focus (Giunipero & Percy, 2000), processes can be standardized. In particular, major companies with large production facilities, high capital investment in IT and infrastructure, and high SCM maturity levels are able to standardize their supply chain activities. By integrating and implementing technical solutions, lean practices and automated systems, and fostering close collaboration with suppliers and customers, these companies are less dependent on human interaction and contributions. Therefore, SCM knowledge mainly has an organizational character. This finding holds particularly true for products in a later stage of the product life cycle. Furthermore, because employee fluctuation in times of “talent wars” is common, companies must act to retain valuable knowledge within their companies. Large-scale databases, comprehensive manuals, operational guidelines, written procedures and detailed job descriptions are all means of retaining knowledge in organizations.

Individual competencies also play a major role. Based on their personal experience and knowledge, supply chain personnel need to interpret information so they can make educated decisions; particularly in situations in which only a limited number of standardized processes exist. For example, during the implementation of new SCM processes such as new product launches, the responsible employees’ contribution is highly significant. SCM applications need to be developed from scratch here, and employees need to understand uncertainties such as unclear customer demand and the sudden appearance of supply chain glitches. This forces SCM personnel

to be alert and react swiftly to upcoming issues. Once a process is streamlined, human capabilities are free to become involved in new activities.

2.6 Conclusion

This paper investigates the effects of individual SCM competencies and organizational SCM knowledge on SCM and financial performance, considering the effects of organizational learning and corporate training. This study at the intersection of SCM and HRM research addresses numerous calls to acquire further insight into the human side of SCM (Gattorna, 2006; Fisher et al., 2010). Although several authors have addressed organizational learning, knowledge and competency issues, to the best of our knowledge this paper is the first one that incorporates these issues in one model. This paper contributes to the body of knowledge in several ways.

2.6.1 Contributions to the Literature

The theoretical contributions of this paper are manifold. Most importantly, our study takes an interdisciplinary approach to integrating HRM concepts into the SCM literature by using the knowledge-based view as its theoretical foundation. It supports eight hypothesized relations and partially supports two, meaning that we have found support for the comprehensive model of value creation through the development of SCM competencies and knowledge. Furthermore, the model clearly reveals the impact of HRM activities on individual competencies. Most of the related findings agree with previous studies that separately investigated the effect of training and related HRM activities (Ellinger & Ellinger, 2014; Ahmad & Schroeder, 2003), organizational learning (Hult, Ketchen Jr. & Nichols Jr., 2003; Ellinger & Ellinger, 2002) and competency and knowledge (Hult et al., 2006; Ellinger et al., 2011) on SCM, operations, purchasing and/or company financial performance. However, our paper measures the effect sizes of these concepts in relation to each other, showing that these concepts should not be treated as isolated elements. Instead, they are connected: organizational learning indirectly affects SCM performance by enhancing individual

competencies and organizational knowledge, for example. The indirect effect is split evenly between the two components. This perspective extends previous academic work, which focused on studying organizational learning's direct effects on various performance measures. The absence of a substantial positive effect of corporate training on competencies contradicts other studies that indicate the positive effects of management training programs (Aguinis & Kraiger, 2009; Gowen & Tallon, 2003). Furthermore, we disentangle the broad definition of "knowledge" and thereby foster a more profound understanding of competency by distinguishing between its individual and organizational dimensions. In particular, we show that both components contribute almost equally to SCM performance. Organizational learning strongly influences both dimensions positively, making it a crucial prerequisite for strong competency and organizational knowledge dimensions.

2.6.2 Managerial Implications

Our findings have three managerial implications. Firstly, the results suggest that, overall, corporate training programs appear relatively ineffective at developing the required supply chain personnel competencies. The positive effect is insignificant, particularly in comparison to the substantial positive effect of organizational learning on individual SCM competencies. Considering the monetary investment involved and the company effort put into training programs, this finding is particularly surprising. Poor employee development programs lead to further problems, particularly for smaller companies. If they are unable to develop SCM employee competencies, companies must recruit highly skilled employees instead. However, smaller companies may not attract top talents due to unfavorable salary levels and ultimately struggle with their recruitment efforts. These companies are under more pressure to develop their employees in house and should improve their training results by consulting external resources that are specialized in training program design. Secondly, organizational learning's strong direct effect on

organizational knowledge and individual competencies and its indirect effect on SCM performance has two implications for SCM: (i) it should serve as 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. Finally, the fact that both dimensions affect performance indicators to similar magnitudes emphasizes that companies cannot afford to focus on developing only one. Instead, companies require cohesive strategies for improving both dimensions simultaneously.

2.6.3 Limitations and Future Research

Our study is subject to certain limitations, many of which we previously laid out in the relevant sections. We surveyed 273 supply chain and SC-related managers from North and Central Europe. Therefore, our results cannot necessarily be generalized to US or Asian companies or other European countries. As in any survey-based research, we rely on the assumption that the respondents are knowledgeable with regard to the topic, read the questions carefully and answer them truthfully. Furthermore, due to the anonymous nature of the survey, we could not obtain objective, secondary data for measuring the SCM and firm financial performance of the companies involved. Instead, we rely on subjective respondent information. However, previous research has shown that the performance data obtained through surveys are reasonably reliable when compared to actual financial figures (Carr & Pearson, 1999).

This study opens up avenues for further research. We surveyed the current state of the respective, company-internal research constructs. Consequently, a longitudinal, in-depth case study including multiple companies would be of great interest. For instance, a research team could accompany companies that are restructuring their employee development programs to observe and measure key improvement factors over time. And the exchange of knowledge and joint organizational

learning in supplier-buyer dyads could help reveal the impact of these factors across company boundaries. Finally, we encourage more research on HRM-related topics in SCM.

Appendix 2-A: Results of 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	0.748	9.337
IDIST1	0.673	13.235
IDIST2	0.927	24.082
IDIST3	0.931	-- ^{a)}
Information Acquisition	0.858	--
IACQ1	0.567	8.306
IACQ2	0.812	11.889
IACQ3	0.780	--
Information Absorption	0.765	8.622
IABSO1	0.691	10.241
IABSO2	0.730	11.486
IABSO3	0.810	--
Corporate Training		
TRAIN1	0.781	13.529
TRAIN2	0.806	13.795
TRAIN3	0.806	13.795
TRAIN4	0.793	--
Firm Financial Performance		
FFP1	0.838	16.406
FFP2	0.909	18.655
FFP3	0.928	19.156
FFP4	0.818	--
SCM Performance		
SCMP1	0.541	8.170
SCMP2	0.656	9.940
SCMP3	0.645	9.629
SCMP4	0.663	--
SCMP5	0.836	9.629
SCMP6	0.911	12.428
INDIVIDUAL SCM COMPETENCIES		
SCM Core Competency	0.983	--
CSCM1	0.778	--
CSCM2	0.726	12.514
CSCM3	0.692	11.922
Managerial Competency	0.861	11.775
CMGMT1	0.811	--
CMGMT2	0.761	13.070
CMGMT3	0.674	11.483

Construct items	Standardized estimates (factor loadings)	t-values (all significant at p<0.001)
IT Competency	0.714	10.535
CIT1	0.856	--
CIT2	0.877	18.231
CIT3	0.792	15.438
ORGANIZATIONAL SCM KNOWLEDGE		
Knowledge Access	0.686	--
KACC1	0.906	--
KACC2	0.785	14.934
KACC3	0.768	14.490
Knowledge Intensity	0.856	8.985
KINTENS1	0.843	17.369
KINTENS2	0.911	19.969
KINTENS3	0.867	--
Knowledge Use	0.821	8.904
KUSE1	0.820	16.545
KUSE2	0.879	18.667
KUSE3	0.882	--

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

See Appendix for more details on question items and design

Appendix 2-B: Questionnaire

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, Sapienza & Almeida, 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 & 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 & Waller, 2013; Beamon, 1999; Gunasekaran, Patel & McGaughey, 2004; Ho, Au & Newton, 2002; Gunasekaran & Kobu, 2007; Narasimhan & Das, 2001; Rexhausen, Pibernik & Kaiser, 2012)
SCMP2	...quality	
SCMP3	...responsiveness	
SCMP4	...innovation	
SCMP5	...improvement (of overall supply chain performance)	
SCMP6	...overall supply chain performance	
Firm Financial Performance	How have the following financial performance measures of your firm developed over the last 3 years? 1 = Decreased significantly, 7 = Increased significantly	
FFP1	Return on investment (ROI)	(Carr & Pearson, 1999; Rexhausen, Pibernik & Kaiser, 2012)
FFP2	Profits as percentage of sales	
FFP3	Earnings before interests and taxes (EBIT)	
FFP4	The present value of the firm	
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)

Item	Question text – All answers on 7-point Likert scale Standard scale: 1 = Strongly disagree, 7 = Strongly agree	References
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 & Larson, 2001; Murphy & Poist, 1991; Murphy & Poist, 2007; Giunipero & Percy, 2000)
CIT2	...in working with large amount of data.	
CIT3	...in working with decision-support systems.	
Management Competency	Our SCM personnel have excellent skills...	
CMGMT1	...to plan, organize, and lead projects.	(Gammelgaard & Larson, 2001; Murphy & Poist, 1991; Murphy & Poist, 2007; Giunipero & Percy, 2000)
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 & Larson, 2001; Murphy & Poist, 1991; Murphy & Poist, 2007; Giunipero & Percy, 2000)
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 & 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.	

3 Career Patterns of Supply Chain Executives: An Optimal Matching Analysis

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Abstract

This exploratory study analyzes the careers of 307 supply chain executives. Motivated by career theory, our findings create new knowledge about the educational backgrounds and career paths that lead to supply chain executive positions. Based on an optimal matching analysis, we are able to distinguish among six career patterns for supply chain executives. They differ in terms of the individuals' previous professional experience, educational background and the time they needed to arrive in an executive position. By characterizing the backgrounds and career paths of supply chain executives, we show that supply chain management is truly a cross-functional profession. Our findings suggest that previous staff responsibility appears to be a more important hiring criterion than extensive supply chain management experience. While 56% of the executives had prior staff responsibility, only 12% of the cumulated careers were actually spent inside the supply chain management function.

Keywords: Career Patterns, Supply Chain Management, Executives, Optimal Matching Analysis, Human Resource

3.1 Introduction

Mounting evidence indicates a shortage of qualified supply chain personnel on a global scale (Cottrill, 2010). Given the fact that the complexity of global supply chains is increasing, it is not surprising that the demands on supply chain managers have changed (Harvey & Richey, 2001). A recent global survey of almost 600 supply chain management (SCM) professionals revealed that organizations lack an understanding of their supply chain talents and how to support their recruitment, succession planning, training and development (John, 2015). This lack of understanding of the people who manage supply chains deserves attention (Wieland, Handfield & Durach, 2016) because SCM is driven by human interaction (Sweeney, 2013). Companies are now aware that superior SCM competency positively influences firm financial performance (Ellinger et al., 2011). This competency is directly related to supply chain personnel. Despite standardized processes and extensive technological support systems, humans must make crucial supply chain decisions (McCarter, Fawcett & Magnan, 2005). In particular, supply chain executives (SCEs) – decision makers with high-level management responsibility – heavily influence company performance. Acquiring knowledge about the backgrounds and career paths that are associated with the SCM function is a means of learning more about key SCM talent, which should be of particular interest to scholars and practitioners for two reasons. Bird (1996) says that through their evolving careers, people accumulate information and knowledge, which are embodied in skills, expertise and relationship networks. This information and knowledge add value to a firm. In other words, previous career positions serve as sources of the competence and experience that SCEs use to make the right decisions.

A career can be defined as “cumulative work experience over the entire life span” (Hall & Las Heras, 2010, p. 449). Spilerman (1977) described the term more technically: as a sequence of job positions over time. Careers constitute a rich source of data, making them highly valuable for

academic studies. Given the extraordinary nature of SCM, the lack of knowledge about the backgrounds of SCEs is particularly surprising: the profession breaks down functional silos and connects many different entities across intra- and inter-company boundaries (Lambert & Cooper, 2000). To be successful in SCM, executives must possess profound cross-functional knowledge of various business fields, strategic decision-making and communication skills, and strong analytical competencies; all of which are necessary to manage the manifold tasks that these executives face on a daily basis (Gammelgaard & Larson, 2001; Hohenstein, Feisel & Hartmann, 2014). Moreover, its global connectivity and intercultural teams and relationships distinguish SCM from other departments (Cottrill, 2010). As the distinctions we outline indicate, SCM demands diverse skills of its employees. Since careers shape and influence individuals' skills and knowledge, it is worthwhile to specifically investigate their characteristics. In this study, we focus particularly on the "executive" level. SCEs already have well-established careers and their histories contain large amounts of information in the form of previous job positions, functions, industries and companies. In addition, they are decision makers with the power to heavily influence their firms' success. And managers that have advanced to an SCE position can be regarded as examples of successful careers.

In particular, we focus on a set of three research questions in this paper:

RQ1: *What are the educational backgrounds of supply chain executives?*

RQ2: *Are there career patterns among supply chain executives and if so, what are their characteristics?*

RQ3: *What are the drivers of rapid career advancement into supply chain executive positions?*

The remainder of the paper is structured as follows: in Section 3.2, we present an overview of the relevant literature on career theory and managerial/SCM career research, and elaborate on our research questions. In Section 3.3, we provide a comprehensive overview of the data collection and sample selection processes. In Section 3.4, we present optimal matching analysis (OMA) as an appropriate research methodology and describe the methodology in detail. In Section 3.5, we present our empirical results. Finally, we conclude and discuss the limitations of this study and future research opportunities in Section 3.6.

3.2 Literature Review and Development of Research Questions

3.2.1 Career Theory and Research

Career theory can be defined as “the body of generalizable attempts to explain career phenomena” (Arthur, Hall & Lawrence, 1989, p. 9). It takes an interdisciplinary approach across various social sciences fields, including psychology, sociology, economics and history. From a psychological viewpoint for example, career theory can guide individuals and organizations to fill job openings in a mutually beneficial way (e.g. Holland, 1997) and enable economists to study the long-term accumulation of human capital (e.g. Becker, 1993). One impactful career theory that emerged in the 1990s is the “boundaryless career,” which was developed by Arthur (1994), DeFillippi and Arthur (1994), and Arthur and Rosseau (1996). Arthur and Rosseau (1996) describe careers as boundaryless in many ways: people move through different functions, organizations, industries and locations during their careers. The revolutionary concept of the boundaryless career stands in stark contrast to earlier theories that assumed a lifelong employer-employee relationship and a strong focus on a specific type of job throughout a career (Super, 1957).

Another main characteristic of career theory is that it encourages the study of individuals, institutions and their coherence (Arthur et al. 1989). A career is described by the traits of the individual, the characteristics of the working environment and – most importantly –

the person-environment match (Betz, Fitzgerald & Hill, 1989). Both employee and employer will only experience adequate job performance if there is congruence and correspondence between the individual's traits and the working environment's requirements. Finding congruence, therefore, is of essential interest to both employee and employer. Human resource management (HRM) departments in particular are compelled to learn more about which people match the job requirements best in order to derive staffing strategies and design career systems (Sonnenfeld, 1989). In this study, we advance the knowledge of the backgrounds and career movements of SCEs who are in place today as a means of supporting the two groups of stakeholders in career and staffing decisions. We also aim to show whether SCE movement supports the boundaryless career theory in terms of constant movement through different functions and industries.

3.2.2 Supply Chain Executives

The developmental career view describes executives as individuals who “provide direction for a significant part of the organization, exercise significant formal and informal power and sponsor promising individuals to (...) prepare them for key roles in the organization in the future” (Dalton, 1989, p. 97). These traits make executives particularly interesting for career studies. Researchers have applied several definitions of “executives” and have researched various target groups (Menz, 2012). They have investigated top management teams (TMTs) (e.g., Hambrick & Mason, 1984), CEOs (e.g., Hambrick & Cannella, 2004), CFOs (e.g., Zorn, 2004), and supra-TMTs (e.g., Finkelstein, Bambrick & Cannella, 2009), among others. However, SCEs have been the targets of relatively little research because the term “SCE” is not unambiguously defined, and the perception of SCM and its tasks in practice remain fuzzy (Fawcett, Magnan & McCarter, 2008). It is not surprising that different definitions have been applied in the literature. For instance, Wagner and Kemmerling (2014) study the presence of chief supply chain officers (CSCOs) in corporate upper echelons. In their sample, they consider the job titles “CSCO,” “executive vice president” and

“vice president” as SCEs. Hendricks et al. (2014) investigate the stock market reaction to appointments of supply chain and operations executives. They extend the search terms for SCEs to “chief,” “(vice) president,” “director” and “head.” Likewise, the Council of Supply Chain Management Professionals (CSCMP) advocates a broader definition of “executives,” proposing a model that distinguishes among three primary levels in SCM: “executives,” “managers” and “analysts” (CSCMP, 2010). According to the council, a supply chain executive “leads the development and implementation of supply chain strategy to support enterprise goals” (CSCMP, 2010). This definition complies with the description by Dalton (1989) and is also applicable to the labels used by Hendricks et al. (2014). In line with those authors and the CSCMP’s definition (2010), we consider “CSCOs,” SCM “(executive/senior) vice presidents,” “directors” and “heads” (and the equivalents “principals,” “leaders” and “Leiter”¹¹) to be SCEs in this study. Table 3-1 provides an overview. Moreover, we list the manager and analyst levels according to the CSCMP definition that were deliberately excluded from this study (see also section 3.3.1).

TABLE 3-1: MANAGEMENT LEVEL CATEGORIES

Category	Management level title	Most frequent job titles
Executives	SVP, VP, Director, Head of, Leader, Principal	Head of SCM Director of SCM Leiter* SCM Vice-President SCM
<i>Managers</i>	<i>Senior Manager, Manager</i>	<i>Supply Chain Manager</i> <i>Senior Supply Chain Manager</i> <i>Supply Chain Project Manager</i> <i>Senior Expert SCM</i>
<i>Analysts</i>	<i>Analyst, Planner, Specialist</i>	<i>Supply Chain Analyst</i> <i>Supply Chain Planner</i> <i>Supply Chain Controller</i>

*German term for “Head”

Italics = not subject of this study

¹¹ German term for “head”.

3.2.3 Educational Background

SCM is a relatively young discipline. Despite the rapidly growing recognition of SCM that emerged in the 1980s, the debate on how to define it still continues (Mentzer, Stank & Esper, 2008). The lack of a clear definition also affects SCM education: universities have established programs for SCM only recently (Korn, 2013) and the university programs that do exist differ significantly in various ways. While SCM programs are under the umbrella of the business schools or business administration programs of some universities, they are part of the engineering schools at others (Cottrill & Rice Jr., 2012). Therefore, the field of study and/or which type of degree today's SCEs hold is unclear. Advanced education should provide people with greater knowledge that will enable them to perform their tasks and jobs successfully. Studies have shown that academic or educational qualifications can predict job performance in management-related and other skilled occupations (Myers et al., 2004; Singer & Bruhns, 1991). Education can be considered the foundation for a person's later career, since it provides the theoretical tools necessary to fulfill the tasks in a job description. Therefore, our first research question is:

***RQ 1:** What are the educational backgrounds of SCEs?*

3.2.4 Career Research and Pattern Analysis

Identifying the factors that underlie career paths has served as motivation for research on career or life course patterns for a wide variety of target groups. Career patterns can be defined as the recurrence of similar career paths among several individuals that indicate structural commonalities in their careers (Anderson, Milkovich & Tsui, 1981; D'Amico, 1985). Studies have considered subjects such as musicians' careers (Abbott & Hrycak, 1990), the labor market trajectories of British women in generation X (Anyadike-Danes & McVicar, 2010) and the trajectories of British criminal careers (McVicar & Anyadike-Danes, 2010). Managerial careers have also been studied frequently. Although careers are shaped by individuals and their own

decisions, there is no doubt that career patterns exist (Pollock, Antcliff & Ralphs, 2002). Research has been conducted on the career patterns of executive women in finance (Blair-Loy, 1999), college and university presidents (Wessel & Keim, 1994), TMT members (Biemann & Wolf, 2009) and expatriates (Andresen & Biemann, 2013). Although there have been a reasonable number of managerial career studies, few papers in the SCM and organizational management literature have addressed this research topic. Ohio State University conducts two annual studies: “Career Patterns of Women in Logistics” (for 18 years) (e.g. Cooper et al., 2011) and “Survey of Career Patterns in Logistics and Supply Chain Management” (for 40 years) (e.g. Cooper et al. 2012). The two surveys chronicle the current status of and trends in logistics/SCM and monitor the evolution of the profession (La Londe et al., 2010). Despite the valuable insights that these surveys provide, they are not designed to reflect the respondents’ careers as a whole. Motivated by this prior research, we are the first to analyze career paths in SCM and reveal their patterns. This holistic approach leads to our second research question:

RQ 2: *Are there career patterns among SCEs and if so, what are their characteristics?*

3.2.5 Career Advancement in SCM

Ultimately, we are interested in “successful” SCM careers. Many employees never attain executive positions in SCM and others climb the career ladder slowly; however, very successful employees may advance within a few years. Because careers differ in their overall duration and also in the time that elapses before an individual’s first SCE position, we are interested in the objective determinants of steep career trajectories. Determinants of career success have been studied in the psychology and management literature. Ellis and Heneman III (1990) use survey data to investigate the career success general managers. They measure career success using hierarchical level and salary, finding that industrial and functional mobility is the only significant predictor. Kirchmeyer (1998) examines gender differences in determinants of managerial career

success and finds that gender acts as a moderator for multiple factors. Seibert et al. (1999) study the effects of a proactive personality on career success and find that a proactive personality is associated with salary, promotions and subjective career satisfaction. *SCM World's* annual "Chief Supply Chain Officer Report" identifies "offering staff a compelling career progression" as today's second most serious HRM challenge (O'Marah et al. 2014). Recruiting and retaining promising SCM employees with ambitious career goals is a challenge if companies are not able to tell them what they must do to succeed and become eligible for future leading roles. Identifying the drivers of rapid career advancement could assist ambitious employees and companies that seek to define "success profiles." The third research question is:

RQ 3: What are the drivers of rapid career advancement into SCE positions?

3.3 Data

3.3.1 Data Collection

We collected SCE resumes from XING, a German social network for business professionals that is comparable to LinkedIn. With more than 10 million registered users (XING, 2016), XING is the market leader in Germany, Austria and Switzerland. An online user profile consists of a full resume (CV) and relevant information about the user's professional career and educational background.

To evaluate the representativeness, correctness and completeness of the data from this source in advance, we used a two-step approach. First, we assessed various descriptive statistics published in different corporate reports. According to the service's demographic report (XING, 2015), the distribution of age groups is relatively balanced among users. And XING enjoys especially widespread use among higher-earning managers – our target group (XING, 2010). Headhunting agencies and HR departments, including 17 of the 30 largest German companies and

over 2,000 firms in total (XING, 2015), rely heavily on this network for recruitment. XING profiles have become essential virtual business cards for business professionals, who keep them up to date. As a second step in evaluating this data source, we assessed the correctness and completeness of XING user profiles by conducting 20 semi-structured telephone interviews with SCEs who are XING users. None of the 20 CVs described verbally during the interviews deviated from the associated XING profiles. As a further proxy for the representativeness of the data from XING, we estimated the usage rate among SCEs. We asked two major companies – a consumer goods manufacturer and a retailer – to share the current organizational charts of their SCM departments. We found that 86% and 58% of their SCEs respectively have a XING account. Given all of the above information, we conclude that XING serves as a reliable and representative data source for our study purpose.

We collected the data in two waves between October 2012 and March 2013. First, a student assistant downloaded the user profiles from approximately 1,500 different supply chain professionals, structuring the search by company lists and keywords. The lists included publicly listed companies,¹² the largest family-owned companies in Germany, the largest American and Asian companies operating in Germany, and the largest firms in Switzerland and Austria based on annual revenues. In addition to the company names, the keywords “supply chain” and “SCM” were used to find managerial personnel who were employed in an SCM position at the time the data were gathered. To also include the CVs of SCEs from companies that were unknown to us, we undertook a second wave of data collection using the above-mentioned keywords but without any company names. This data collection procedure is in line with previous studies that generated

¹²We include the 30 companies listed in the main German stock market index DAX (Deutscher Aktien Index), the following 100 largest companies listed in the MDAX (Mid-Caps-DAX), the 50 companies listed in the SDAX (Small-Caps-DAX), and the 30 largest companies from the technology sector listed in the TecDAX (Technology-DAX).

database by searching commercial online platforms using keywords (e.g. Rossetti and Dooley 2010).

After the initial data was collected, the co-authors evaluated all of the profiles and identified 307 resumes that qualified for our study based on the following criteria. First, as elaborated in section 3.2.2 and summarized in Table 3-1, only SCEs based on their job titles were included in our sample – managers and analysts were excluded. Second, we only used resumes that contained complete information on the individual’s education and professional career as shown in Figure 3 below. Third, our use of the keywords “supply chain” and “SCM” ensured that one of those terms was included in the job titles. We consciously decided to focus on “true” SCEs to clearly distinguish between SCM and adjacent functions. We understand SCM as an independent function with unique requirements and responsibilities within and across companies that go far beyond traditional logistics management, operations or procurement, as also argued in previous studies (Giunipero & Brand, 1996; Cooper, Lambert & Pagh, 1997; Mentzer, Stank & Esper, 2008; Rossetti & Dooley, 2010). Therefore, we omitted executives who are currently employed in adjacent functions to focus specifically on supply chain executives.

3.3.2 Data Classification

We expended significant amounts of time and effort during the data collection process to standardize and code the hundreds of different job titles and job descriptions, functions, industries and hierarchical levels. To define the industry categories, we used the FTSE Group (2013) Industry Classification Benchmark (ICB). The ICB distinguishes among the 19 “super sectors” listed below. The majority of the SCEs work or have worked in the eight industries that are listed in Table 3-2. The remaining 11 super sectors (banks, basic resources, construction & materials, financial services, insurance, media, oil & gas, real estate, telecommunication, travel & leisure and utilities) are grouped together in “Others,” as only a minor share of the SCEs were exposed

to those sectors during their careers. The choices of functional categories were derived inductively from the CVs in the data sample. After our review and assessment of the sample's several hundred resumes, we decided to distinguish among the 14 functions mentioned in Table 3-2.

TABLE 3-2: APPLIED CLASSIFICATION OF INDUSTRIES AND FUNCTIONS

Industries	Functions
Automotive & parts	Business strategy
Chemicals	Consulting
Food & beverages	Controlling & finance
Healthcare	HR
Industrial goods & services	IT
Personal & household goods	Logistics
Retail	Procurement
Technology	Production
Other	Project management
	Quality
	R&D
	Sales & marketing
	Supply chain management
	Trainee

While the majority of the functions listed are commonly used, we briefly explain some of our reasons for using this list. As marketing and sales are closely related functions that are joined together in many firms (Ocasio & Kim, 1999), we combined them into the "Sales & marketing" category. "Trainee" is listed as a separate function because in most companies, these programs are cross functional. Since many executives in our sample held job positions that contained the terms "consulting" (often in-house consulting), "project management," "quality" and "business strategy" in their job titles, we list them as separate functions.

Table 3-3 provides a summary of the data sample. On average, the executives have 15.6 years of total business experience. Female SCEs comprise 8.8% of our sample. The small share of women in SCM is in line with recent studies that found SCM to be a male-dominated profession

(Hendricks et al. 2014; O'Marah 2014). Of the executives in the sample, 86.6% work in Germany, 8.8% in Switzerland and 4.6% in Austria, a distribution that is proportional to these countries' populations.

TABLE 3-3: SAMPLE INFORMATION

Supply chain executives (n)	307	Country	
Longest career (years)	31	Germany	86.6%
Shortest career (years)	3	Switzerland	8.8%
Average total business experience (years)	15.6 (SD 5.9)	Austria	4.6%
Average time to first SCE position in years (TtSCE)	10.7 (SD 4.3)	Industry	
Share of women	8.8%	Automotive & parts	11.4%
Cohorts		Chemicals	6.5%
21+ years business experience (YBE)	22.1%	Food & beverages	4.9%
11-20 years	57.7%	Healthcare	6.5%
<=10 years	20.2%	Industrial goods & services	30.6%
		Personal & household goods	11.7%
		Retail	5.9%
		Technology	11.1%
		Other	11.4%

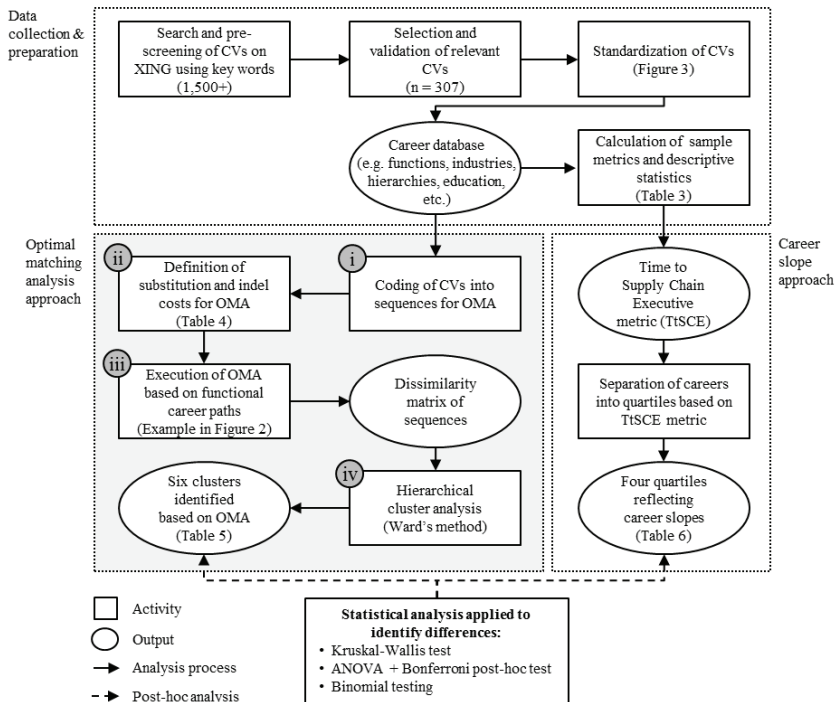
We decided to review sequences (of job positions) only from the time the executives entered the job market to their first appointment to an SCE position, so we curtailed the sequences after the last non-SCE position. There are three reasons for this approach. First, because we define the tenure prior to the first SCE position as the key period for career success, the time between the entry-level position and moving into the first SCE position is of particular interest. Second, by curtailing the sequences, we normalize them by defining a common end-point for all sequences. Third, although the optimal matching analysis methodology is able to compare sequences of different lengths, a substantial difference between two sequences can influence the results. This is undesirable. The allocation and types of elements (functions) should be the main factors. Truncating the sequences reduces the spread in the sequence lengths in our sample.

In addition to the CV data, we used financial data from the German “Firmendatenbank Hoppenstedt,” which is comparable to Standard & Poor’s “Compustat,” to classify companies as large, medium, and small based on their annual revenue.

3.4 Optimal Matching Analysis and Methodological Process

This section describes our primary research methodology in detail. As shown in Figure 3-1, the optimal matching analysis (OMA) approach is key for our methodological process. It requires four activities: (i) coding career paths into sequences, (ii) defining transformation cost rates, (iii) executing the optimal matching analysis and (iv) hierarchical cluster analysis to identify patterns among the career paths.

FIGURE 3-1: METHODOLOGICAL PROCESS



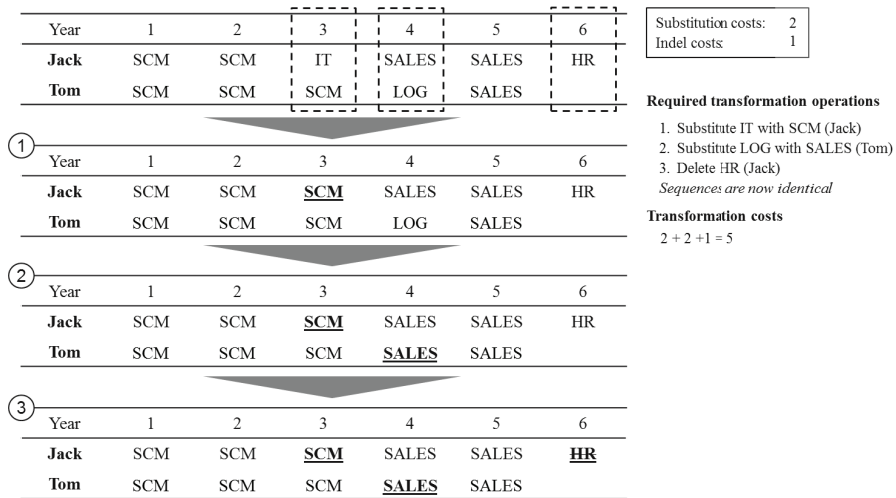
We considered several research methodologies for the analysis, for example, a content analysis to derive a contextualized interpretation of the executives' resumes or a work history analysis that counts the occurrence of certain job attributes. However, the organizational and vocational behavior literature provides more specialized methodologies. In their literature review on managerial career pattern analyses, Vinkenburg and Weber (2012) analyze 33 empirical studies that relied on various types of analysis methods. Based on their research, the authors find that sequence analyses are regularly presented as the most appropriate methodology for career pattern studies because these analyses treat sequences (i.e. careers) as entire trajectories in which entities are intrinsically linked. They incorporate a holistic perspective into the analysis that conventional methodologies are lacking. Furthermore, career studies relying on conventional methodologies often suffer from a lack of clarity and consistency. OMA appears to be capable of overcoming those issues and adding value to research on career patterns (Vinkenburg & Weber, 2012; Han & Moen, 1999). Chan (1995) concurs with this finding and settles on OMA after carefully considering other methodologies.

A sequence consists of a series of elements where each element can have a finite number of states. In our case, 14 different functions represent the states. A 3-year-long career in SCM, for instance, would be coded as SCM-SCM-SCM (sequence A), while a career path through two years of logistics followed by two years in HR would be coded as LOG-LOG-HR-HR (sequence B). Given a set of sequences, the OMA determines the distance between every pair of sequences through an iterative minimization procedure. In other words, the OMA adds up the transformation operations needed to turn sequence A into sequence B or vice versa (Abbott & Forrest, 1986). The transformation is completed when the ordering and position of elements in both sequences are the same and both sequences have the same length, i.e., they are identical. The more operations needed to achieve equality, the greater the dissimilarity between the pair of sequences.

We can distinguish among three different types of transformation operations: substitution, insertion and deletion. The latter two are combined and are referred to as *indel* in the literature. Substitution involves exchanging one element with another in the exact same position in a sequence, e.g., replacing LOG with SCM. Indel involves inserting or deleting an element in a sequence. Indel operations manipulate the length of the sequence (a strength of OMA that enables it to cope with differences in sequence length), whereas substitution does not. These transformations are subject to different cost rates that must be assigned in advance (Scherer, 2001). For substitutions, we can assign different cost rates that depend on the (dis)similarity of the substituted and substituting elements. Substitution cost rates allow the algorithm to weight substitution operations. A higher cost rate reflects greater dissimilarity between two elements and a lower cost rate reflects greater similarity. The algorithm always determines the most efficient solution for completing the transformation from one sequence to the other (Levenshtein, 1966).

A simplified example in Figure 3-2 illustrates the OMA algorithm (adapted from Biemann and Wolf 2009) by considering the careers of Jack and Tom. For simplicity, the indel costs are set to 1 unit, and the substitution costs are 2 units for all substitutions. Jack and Tom's sequences differ in years 3, 4, and 6. The cheapest way to match Jack and Tom is to replace Jack's IT with SCM in year 3 (step 1), Tom's LOG with SALES (step 2) in year 4 and to delete Jack's HR in year 6 (step 3). The transformation requires two substitutions and one indel operation, leading to a total cost of 5 units. Note that there are alternative solutions, e.g., inserting HR in Tom's sequences in step 3 instead of deleting it from Jack's. However, no solution yields a lower cost than 5 units.

FIGURE 3-2: EXAMPLE OF OMA PROCEDURE



3.4.1 Sequence Coding

We first code the CVs into structured sequences to prepare the data for sequence analysis. A sequence is an ordered list of elements (MacIndoe & Abbott, 2004) that can only adopt a finite number of states that must be defined in advance. These states can contain different dimensions of information (Biemann, Zacher & Feldman, 2012). In our case, each job position can be broken down separately into the dimensions of function, industry and hierarchical level for each year, as illustrated in Figure 3-3. However, coding job positions based on our pre-defined three dimensions would result in 378 possible states (14 functions x 9 industries x 3 hierarchical levels). Clearly, this number of states is too large and unmanageable. For our OMA, we choose to focus on functional coding. This decision means that the OMA is performed based on individuals' "functional career" without considering industries or hierarchical levels. However, we include the other dimensions in the subsequent analysis.

FIGURE 3-3: CODING OF SAMPLE CV

Social network CV representation		Standardized CV representation			
Tenure (month/year)	Job title & details	Year	Function	Level	Industry
09/2011 – 10/2012	Head of Supply Chain Processes Director, with staff responsibility Auto Corp.	0	SCM	Executive	Automotive & Parts
06/2008 – 08/2011	SAP ERP Manager Manager, no staff responsibility Pharma Corp.	-1	IT	Manager	Healthcare
06/2006 – 05/2008	Business Analyst in Logistics Employee, no staff responsibility Supermarket Corp.	-2	IT	Manager	Healthcare
		-3	IT	Manager	Healthcare
		-4	LOG	Analyst	Retail
		-5	LOG	Analyst	Retail
2001 – 2006	MSc. in Business Administration Open University, Germany	Used as input for OMA			

Their function should have the greatest influence on a person's career, because a large share of a person's knowledge (and therefore, his/her human capital) is task-specific, acquired through learning by doing on the job (Gibbons & Waldman, 2004). For example, the tasks of a human resource manager and a supply chain manager differ significantly, and it would be challenging for these two individuals to trade jobs without an initial loss in productivity. Two human resource managers from different industries, however, could swap jobs relatively easily, as most of their core responsibilities (advertising vacant positions, concluding contracts, etc.) are not heavily affected by the industry in which they work. A co-author initially coded the resumes into sequences. To ensure high reliability, a second researcher repeated this process independently. We calculated Cohen's kappa as a statistical measure for inter-rater reliability (Cohen, 1960; Grayson & Rust, 2001), and the result is $\kappa = 0.68$. According to Landis and Koch (1977), kappas between 0.61 and 0.80 are considered to show substantial agreement between coders. Therefore, we are confident that coder subjectivity is not an issue in our data.

3.4.2 Cost Rate Assignment

Choosing cost rates has been discussed repeatedly (e.g., Wu, 2000; Hollister, 2009) because this process impacts the results of the OMA. However, several researchers agree that career data are strongly patterned, and these patterns will show up regardless of which costs the researchers assume (Abbott & Tsay, 2000; McVicar & Anyadike-Danes, 2010). Indel costs are defined only once, which means that insertion and deletion cause the same cost every time the operation is performed regardless of which elements are affected. In contrast, substitution costs are defined using a substitution cost matrix because substituting A with B could be more (or less) costly than substituting A with C (Stovel & Bolan, 2004).

We derived the substitution costs from the underlying dataset, as this approach yields robust results (Hollister, 2009; Anyadike-Danes & McVicar, 2010; Brzinsky-Fay & Kohler, 2010). Here, substitution costs are derived from the inverse of the transition frequencies in the dataset, which means that low costs are assigned to job transitions that are frequently observed in the dataset (e.g. job changes from logistics to SCM) and high costs to infrequent transitions (e.g. switches from HR to SCM). We capped the maximum cost rate at 2 units to ensure a reasonable range for the cost rates, in line with other OMA research ((Biemann, Zacher & Feldman, 2012); (Biemann & Wolf, 2009)). Because OMA requires a symmetric substitution cost matrix (Brzinsky-Fay, Kohler & Luniak, 2006), we first calculated the inverse transition frequency for a pair of functions in both directions and then set the average as the symmetric cost rate shown in Table 3-4. The impact of the relationship between substitution and indel costs must be taken into account in a second step. We followed Abbott's approach and set the indel cost at 10% of the largest substitution cost rate (in our case, 0.2 units), as this procedure "tend[s] to pick up the sequence regularities that appeared to be substantively interesting" (Abbott & Tsay, 2000).

TABLE 3-4: SUBSTITUTION COST MATRIX

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Business strategy	1	0.00													
Consulting	2	0.22	0.00												
Controlling & finance	3	0.11	0.13	0.00											
HR	4	2.00	2.00	2.00	0.00										
IT	5	1.07	0.20	0.23	2.00	0.00									
Logistics	6	0.43	0.17	0.45	1.18	1.07	0.00								
Procurement	7	1.08	0.17	0.26	1.80	1.80	1.39	0.00							
Production	8	0.51	0.30	0.28	2.00	2.00	0.15	0.20	0.00						
Project management	9	0.20	0.14	0.17	2.00	0.18	0.12	1.02	0.13	0.00					
Quality	10	2.00	1.08	2.00	2.00	2.00	1.08	1.08	2.00	1.03	0.00				
R&D	11	1.08	0.30	2.00	2.00	2.00	0.15	2.00	0.30	1.02	1.04	0.00			
Sales & marketing	12	1.05	1.07	0.23	1.04	1.06	1.08	0.20	2.00	1.04	1.03	1.05	0.00		
SCM	13	0.13	0.28	0.17	1.01	0.36	0.04	0.07	0.16	0.22	1.02	0.16	0.13	0.00	
Trainee	14	2.00	1.05	1.11	2.00	1.11	1.02	1.04	0.61	1.05	2.00	0.61	1.05	1.02	0.00

Note: Indel cost = 0.2

3.4.3 Optimal Matching Implementation

After coding the data and assigning the cost rates, we used the Stata 12 statistical software to run the OMA. Stata calculates pairwise comparisons for all unique sequences in the sample using the Needleman-Wunsch algorithm (see Needleman and Wunsch 1970). The output consists of a dissimilarity matrix that contains the distances between all of the SCE career sequences. The dissimilarity matrix is used as the input for the hierarchical cluster analysis.

3.4.4 Hierarchical Cluster Analysis

We used Ward's method to cluster career paths with small distances between them into career patterns¹³ (Ward Jr. 1963). To determine the correct number of clusters, we used the Duda-Hart Je(2)/Je(1) stopping rule index (Duda, Hart & Stork, 2000). Milligan and Cooper (1985) find that the Duda-Hart and Calinski-Harabasz indices are the best of the 30 stopping rules and are the ones most frequently used in (hierarchical) cluster analyses to calculate the optimal number of clusters.

¹³ The terms "pattern" and "cluster" are used interchangeably hereafter.

The Duda-Hart index is computed for each cluster solution. Higher index values indicate more distinct clustering (favorable). In our case, the Duda-Hart criterion suggests a six-cluster solution.

3.5 Results

3.5.1 Educational Background of Supply Chain Executives

With regard to our first research question, we find that SCEs in Germany, Austria and Switzerland typically possess strong academic backgrounds. Table 3-5 shows an overview of the educational statistics (“Overall” column). Of all of the SCEs, 87.4% hold either a graduate degree or a Ph.D. Conversely, only 8.4% launched a career from an apprenticeship position. Unlike in the United States and the rest of the Anglosphere, where Ph.D. degrees are usually regarded as qualifications for an academic career, it is not unusual for individuals in German-speaking countries to earn a Ph.D. first and then move into industry.

Another characteristic of the German educational system is the apprenticeship, which has a long and well-respected history. Apprenticeships are typically three-year practical programs that combine working in a company with vocational training. The low share of SCEs who began as apprentices (8.4%) suggests that SCM demands more than a thorough practical education. The majority of SCEs studied business administration or economics (44.2%), followed by engineering (19%) and industrial engineering (14.2%). Although state-of-the-art supply chains are dependent on high-end IT infrastructures and software packages, only 2.2% of SCEs studied computer science. Because our sample consists of executives from different generations, we account for temporal implications. University and apprenticeship programs have changed and developed considerably. For instance, degrees in logistics and SCM have only been introduced recently compared to degrees in mechanical engineering or business administration. To account for the development in the educational sector, we conducted a cohort analysis. We split our sample into three different cohorts: ≤ 10 years of business experience (YBE) (22.1%), 11-20 YBE (57.7%)

and 21+ YBE (20.2%). We compared the types of degrees and the fields of study to reveal differences in the educational backgrounds across cohorts. We find that the youngest cohort has obtained slightly more academic education than the most-senior cohort: 85% of the younger cohort holds a graduate degree and 10% a Ph.D., while only 75% and 5% of the older cohort had received a graduate degree or Ph.D., respectively. The academic background finding is unsurprising, given the complexity of the tasks associated with SCM today. In fact, demands on supply chain personnel have increased in recent years (Cottrill, 2010). In terms of fields of study, it is apparent that the share of mechanical engineers has decreased from 22% (21+ YBE) to 16% (11-20 YBE) to only 5% (≤ 10 YBE). Conversely, graduates of “logistics” courses have increased from 0% among the older cohort to 16% among the younger cohort. Apparently, the specialized curriculum that was not previously available has claimed shares from mechanical engineering as preparation for an SCM-related career. The share of business administration graduates has increased slightly (35% to 41% to 47%).

3.5.2 Career Patterns among supply chain executives

Before we present a more detailed analysis, we must define three metrics. “Total business experience” refers to the respondents’ work experience in years from their first job to the day of data collection. “Time to supply chain executive” (TtSCE) refers to the respondents’ average timespan from their first job to their first SCE position. For the metric “TtSCE by function,” we merged the careers of all SCEs per cluster to determine the distribution of functional experience for each career pattern (measured in years). For example, “50% TtSCE spent in SCM” means that if all of the cluster members’ career years before becoming an SCE are aggregated, we will find that half of this aggregated career was spent in SCM.

Based on the OMA, we identified the six career patterns shown in Table 3-5. Pattern 1 contains 37 sequences. We refer to this cluster as “Demand-siders” because 49.7% of the TtSCE of the

cluster members was spent in sales/marketing – a function that usually emphasizes customer orientation. Pattern 2, “Homegrowns,” corresponds to the homegrown SCEs (64 careers); a total of 58.4% of their TtSCE was spent in SCM and the second largest proportion was in the adjacent logistics function (11.6%). Pattern 3, “Logisticians,” is the largest cluster with 104 career paths (33.9% of the total sample). In this group, a cumulated 68.9% of the TtSCE was spent in logistics, procurement and production. Pattern 4, “Sourcing Specialists,” is the smallest cluster; it contains only 19 careers and 83.1% of the TtSCE was spent in procurement. Pattern 5, “Operations Experts,” has 26 careers and the largest share of individuals with production backgrounds: its members possess the strongest engineering background among all of the clusters. In addition, 79.6% of this cluster’s TtSCE was spent in Production departments. Despite being the third-largest cluster in our study (57), pattern 6 is labeled “Outsiders.” Within this cluster, only 12.9% of the TtSCE was spent in SCM, logistics, production and procurement combined. The most TtSCE was spent in consulting (40.6%) and project management (19.1%) functions.

A high share of former logistics, procurement and production experience in the sample might be intuitively expected, but the mixture of career patterns and the limited exposure to SCM jobs in five of the clusters is surprising. Other than the Homegrowns, only a small number of the individuals had worked in SCM before becoming SCEs, ranging from 24.3% (Demand-siders) to only 5.8% (Logisticians). This observation indicates that many SCEs have limited prior SCM experience. Moreover, the differences in cluster size (fewer Sourcing Specialists and Operations Experts than Demand-siders and Outsiders) were not expected.

TABLE 3-5: OMA CLUSTER SOLUTION

Variables / Metrics	Demand- siders	Home- grows	Logisticians	Sourcing Specialists	Operations Experts	Outsiders	Overall	Kruskal- Wallis test: <i>Chi² values with ties (italic)</i>
	1	2	3	4	5	6	6	Binomial testing (Y = significant)
n	37	64	104	19	26	57	307	
%	12.1%	20.8%	33.9%	6.2%	8.5%	18.6%		
Total business experience (years)	Mean 18.9 ^{2b}	13.5 ^{1a}	16	19.1 ^{2b}	16.2	13.8 ^{1a}	15.6	38.4***
	Std. dev 4.5	5.6	5.8	4.4	6	5.7	5.9	
	Median 18.7	13	15.4	19	15.4	14.1	15.4	
TISCE (years)	Mean 14.5 ^{2b}	8.8 ^{1a}	10.9 ^{1a}	16.2 ^{2b}	11.1 ¹	8.2 ^{1a}	10.7	62.5***
	Std. dev 4.4	5.5	5.4	4.1	5.4	4.2	5.6	
	Median 15.0	7.5	10.5	16.0	10.0	7.0	10.0	
TISCE by function	Business strategy 16.0%	0.0%	2.5%	0.0%	0.7%	2.2%	3.8%	39.4***
	Consulting 0.9%	8.9%	4.6%	1.0%	1.4%	40.6%	9.2%	67.7***
	Controlling/finance 16.0%	1.6%	1.1%	0.0%	1.0%	4.1%	3.9%	17.5***
	IT 3.9%	1.1%	0.2%	0.0%	3.8%	16.6%	3.6%	33.0***
	Logistics 2.4%	11.6%	43.7%	9.4%	2.1%	3.0%	18.8%	92.3***
	Procurement 3.5%	2.1%	14.2%	83.1%	1.0%	5.6%	14.5%	109.9***
	Production 0.0%	1.1%	11.1%	1.9%	79.6%	1.5%	11.4%	75.9***
	Project management 2.2%	5.2%	5.2%	0.3%	5.2%	19.1%	6.2%	20.5***
	Sales/marketing 49.7%	4.3%	9.4%	0.6%	2.8%	1.3%	12.6%	76.9***
	SCM 3.9%	58.4%	1.9%	2.9%	0.7%	2.8%	12.0%	63.1***
Current industry	Others 1.3%	5.9%	6.3%	0.6%	1.7%	3.2%	4.0%	
	Automotive & parts 8.1%	9.4%	10.6%	15.8%	3.8%	10.5%	9.8%	
	Chemicals 10.8%	7.8%	10.6%	10.5%	11.5%	3.5%	8.8%	
	Food & beverages 2.7%	7.8%	8.7%	5.3%	7.7%	5.3%	6.8%	
	Healthcare 8.1%	14.1%	5.8%	15.8%	19.2%	14.0%	11.1%	
	Industrial goods & services 16.2%	25.0%	26.0%	26.3%	7.7%	21.1%	22.1%	
	Personal & household goods 21.6%	15.6%	5.8%	0.0%	23.1%	7.0%	11.1%	
	Retail 5.4%	3.1%	7.7%	0.0%	0.0%	8.8%	5.5%	
	Technology 8.1%	10.9%	10.6%	10.5%	15.4%	15.8%	11.7%	
Industry of first SCE position	Other 18.9%	6.3%	14.4%	15.8%	11.5%	14.0%	13.0%	
	Automotive & parts 8.1%	10.9%	9.6%	15.8%	3.8%	10.5%	9.9%	
	Chemicals 10.8%	7.8%	12.5%	10.5%	19.2%	5.3%	10.6%	
	Food & beverages 2.7%	6.3%	7.7%	5.3%	3.8%	5.3%	5.9%	
	Healthcare 8.1%	15.6%	6.7%	15.8%	15.4%	14.0%	11.2%	
	Industrial goods & services 18.9%	23.4%	27.9%	26.3%	11.5%	22.8%	23.8%	
	Personal & household goods 21.6%	15.6%	5.8%	0.0%	26.9%*	8.8%	10.9%	Y
	Retail 5.4%	3.1%	7.7%	0.0%	0.0%	8.8%	5.6%	
	Technology 8.1%	10.9%	10.6%	10.5%	15.4%	14.0%	11.6%	
	Other 16.2%	6.3%	11.5%	15.8%	3.8%	10.5%	10.6%	
Starting industry	Automotive & parts 5.4%	12.5%	12.5%	26.3%	3.8%	10.5%	11.4%	
	Chemicals 2.7%	9.4%	6.7%	5.3%	15.4%	6.5%	6.5%	
	Food & beverages 0.0%	9.4%	6.7%	0.0%	7.7%	0.0%	4.9%	
	Healthcare 5.4%	9.4%	2.9%	0.0%	15.4%	8.8%	6.5%	
	Industrial goods & services 24.3%	28.1%	28.8%	36.8%	23.1%	42.1%	30.6%	
	Personal & household goods 8.1%	10.9%	14.4%	5.3%	11.5%	12.3%	11.7%	
	Retail 16.2%	1.6%	7.7%	0.0%	0.0%	5.3%	5.9%	
	Technology 18.9%	10.9%	8.7%	10.5%	11.5%	10.5%	11.1%	
	Other 18.9%	7.8%	11.5%	15.8%	11.5%	8.8%	11.4%	
Company size (revenue in €)	< 1 billion 10.8%	14.1%	28.8%	36.8%	38.5%	15.8%	22.5%	
	1-10 bn 54.1%	43.8%	38.5%	31.6%	42.3%	36.8%	41.0%	
	> 10 bn 35.1%	42.2%	32.7%	31.6%	19.2%	47.4%	36.5%	
% of cluster members who were executives in other func.	% 70.3%	17.2%**	69.2%	84.2%*	61.5%	54.4%	56.0%	Y
% of TISCE spent as exec. of other dept.	% 33.0%	5.0%*	35.9%***	45.8%*	43.6%*	28.0%	30.6%	Y
% of managers in SCM before	% 24.3%	98.4%***	5.8%***	15.8%	7.7%*	8.8%***	28.7%	Y
Years in SCM before SCE	Mean 2.3	5.2	3.5	3.0	1.0	2.6	4.5	
% of women in cluster	% 10.8%	9.4%	9.6%	5.3%	7.7%	7.0%	8.8%	
Cohorts n=	21+ years of experience 12	7*	28	8*	4	9	68	Y
	10-20 22	36	59	11	18	31	177	
	<<10 3	21*	17	0*	4	17	62	Y
Level of education	Apprenticeship 13.3%	3.4%	10.0%	29.4%**	4.2%	3.6%	8.4%	Y
	Undergraduate 0.0%	1.7%	4.0%	0.0%	0.0%	3.6%	2.5%	
	Graduate 73.3%	87.9%	79.0%	64.7%	87.5%	78.6%	80.0%	
	Ph.D. 6.7%	6.9%	6.0%	0.0%	8.3%	12.5%	7.4%	
Field of studies	Others 6.7%	0.0%	1.0%	5.9%	0.0%	1.8%	1.8%	
	Business & economics 73.3%***	53.6%	43.8%	31.3%	16.7%**	34.6%	44.2%	Y
	Industrial engineering 6.7%	17.9%	10.4%	18.8%	12.5%**	21.2%	14.2%	Y
	Engineering 10.0%	12.5%	22.9%	6.3%	33.3%	21.2%	19.0%	
	Computer science 0.0%	1.8%	3.1%	6.3%	0.0%	1.9%	2.2%	
	Logistics 0.0%	5.4%	9.4%	12.5%	8.3%	5.8%	6.9%	
	Natural sciences 0.0%	1.8%	1.0%	0.0%*	8.3%	11.5%**	3.6%	Y
	Others 10.0%	7.1%	9.4%	25.0%*	20.8%	3.8%	9.9%	Y

Significance level: *** = p < 0.001, ** = p < 0.01, * = p < 0.05

¹²²⁴⁵⁶. Differences in mean values are at least significant at the p < 0.05 level based on ANOVA + Bonferroni test: E.g., 8.8^{1a} differs from mean of cluster 1 and 4

Kruskal-Wallis test: Measures whether there is a statistically significant difference among the cluster values

Binomial testing: Significance testing based on comparison of cluster values and overall value . E.g. 73.3%*** in cluster 1 means that this value is significantly different from the value in the "Overall" column, at least at a p < 0.001 level

As you recall, we conducted the OMA and cluster analysis at the functional level only. The dissimilarity matrix and subsequently, the hierarchical cluster analysis, are based only on this type of information. It is interesting to see that the career patterns that were generated based on functional backgrounds conceal further distinctions. For instance, only 3.4% of the Homegrowns completed apprenticeships (compared with 29.4% of the Sourcing Specialists).

To identify statistically significant differences between the six clusters and compare them to the overall means, we used the Kruskal-Wallis test, ANOVA with Bonferroni post-hoc tests, and binomial testing. Because our data do not have a normal distribution, we performed the Kruskal-Wallis test to calculate significance levels and chi-squared values with ties for the top three variables (Table 3-5). To test for statistically significant pairwise differences across all clusters, we reverted to an ANOVA with Bonferroni post-hoc procedure for the top two variables. The ANOVA method is known to be relatively robust against slight violations of the normality assumption (Glass, Peckham & Sanders, 1972), as is the case in our study. We found evidence of statistically significant differences in total business experience, TtSCE, and “TtSCE by function” across the six patterns. We used binomial testing to test for statistically significant differences for all of the other metrics against the overall value. With the exception of one single value (Pattern 5, first industry of SCE position: personal & household goods), we find no statistically significant differences in the three industry variables. This means that the six career patterns appear to be robust across industries. However, we find statistically significant differences in most of the remaining metrics across patterns, as described below.

The Demand-siders required 14.5 years (with a standard deviation of 4.4 years) of TtSCE on average; this period was the second longest and was 3.8 years longer than the overall mean. However, 70.3% of these SCEs had previously held executive positions in other functions. The large share of individuals with executive experience suggests that companies prioritize previous

staff responsibility/experience over SCM knowledge. Given that sales/marketing and business strategy are classic business administration functions, it is unsurprising that pattern 1 has the largest share of business and economics graduates (73.3%). In contrast, 98.4% of the Homegrowns were employed in SCM before moving into an executive position. With an average TtSCE of 8.8 years, their average ascent to “head of SCM” required nearly 2 years less than the overall average. However, only 17.2% held previous executive positions in other functions, i.e., the majority spent their entire careers in SCM and were promoted to department head at a certain point. Homegrowns are very well educated: 94.8% hold a graduate degree or a Ph.D. The Logisticians represent the largest cluster. Their TtSCE was 10.9 years. Of the Logisticians, 69% of the aggregated TtSCE was spent in logistics, production and procurement combined, whereas only 1.9% was spent directly in SCM. In addition, 69.2% of this cluster’s members possess previous executive experience and their transition to SCM occurred rather late in their careers. The Sourcing Specialists are the pattern with the slowest ascent (16.2 years) and the highest concentration in one function (procurement, 83.1%); however, 84.2% previously held an executive position. Interestingly, these individuals have a lower level of education, with 29.4% completing an apprenticeship only. The lack of a university degree could harm promotion chances, especially for senior management positions. The Operations Experts spent 79.6% of their TtSCE in production. Unsurprisingly, 45.8% of this cluster’s members hold an (industrial) engineering degree, and 26.9% became SCEs in the personal & household goods industry, which is the only statistically significant difference from the overall mean in the three industry metrics. The majority (38.5%) work in enterprises with revenues of less than €1 billion. The Outsiders comprise the most diversified cluster. With 8.2 years of TtSCE, they have experienced the steepest career trajectories of all of the participants in this study. The Outsiders are also well educated, with 91.1% holding graduate degrees/Ph.Ds. More notably, 47.4% hold SCE positions in very large corporations (> €10 billion revenue), which typically are highly competitive. The fact that

40.6% of the Outsiders are former consultants could explain their above-average career success. Consultants are known to pursue exceptionally ambitious career goals, and their broad knowledge and diverse skills are valued by employers (Kubr, 2002).

Three other anomalies deserve to be highlighted. The Homegrowns' pattern is markedly different from the other five patterns. First, Homegrowns stand out as the most inexperienced executives, with only 17.2% holding executive positions before their promotion to SCE. There is a significant gap between this percentage and the next smallest percentage of SCEs who have held previous executive positions (54.4% for Outsiders). Second, other than the Homegrowns, all of the other clusters show limited exposure to SCM positions, as highlighted above. Third, the cohort metric provides another distinctive feature of Homegrowns: their largest proportion belongs to the youngest cohort, with 10 or less years of business experience. The intuitive explanation for this result could be the young age of the SCM function itself. Especially in German-speaking countries, the concept of supply chain management has been slow to permeate conservative organizational structures. Thus, the option of launching a career in this area has only been established recently.

Summarizing the results provides evidence of six typical career trajectories within our sample of SCEs. Although all careers follow an individual path, there are more similarities among the individual trajectories than we expected.

3.5.3 Drivers of Rapid Ascent to a Supply Chain Executive Position

Interestingly, the OMA-based clusters show substantial differences in career advancement. For example, Outsiders become SCEs an average of 8 years before Sourcing Specialists do. To explain the drivers of steep supply chain career slopes, we conducted further analyses. Unfortunately, no information about performance, grade or skills is available, and the dependent variable TtSCE is

subject to multicollinearity issues if it is explained by the number of years in a given function. Therefore, we sorted the sequences based on the TtSCE, beginning with the shortest (and progressing to the longest). We next split the sample into quartiles and focused particularly on comparing the fastest (Leaders) and slowest (Laggards) quartiles. Table 3-6 provides the descriptive statistics for the career slope analysis. Note that binomial testing compares the values for the first and fourth quartiles, unlike in the previous section, in which binomial testing was performed in relation to the overall means. As in the OMA approach, we performed the Kruskal-Wallis test on the top three metrics. Here, we omitted the ANOVA because the data violates the assumptions of homogeneity of variances and normality.

Our findings indicate statistically significant differences in total business experience, TtSCE, TtSCE by function, industry measures, previous executive experience, cohort affiliation, field of study and level of education; however, the differences in previous functional background are less substantial than those obtained from the OMA six-cluster solution. On average, the Leaders were appointed to SCE positions 14 years before the Laggards (4.3 vs. 18.4 years). The cohort affiliation distribution suggests that it is easier for the younger generation to advance quickly than it was 20 or more years ago. More junior executives had the opportunity to move straight into the “Homegrown” career track, which did not exist in the 1980s and 1990s. On average, Leaders spent a greater proportion of their TtSCE in consulting and SCM functions (the latter is not statistically significant, but is noteworthy) than Laggards. Accordingly, fewer years were spent in production, procurement, logistics and sales/marketing.

TABLE 3-6: CAREER SLOPE CLUSTER SOLUTION

Variables / Metrics		Leaders	2 nd quartile	3 rd quartile	Laggards	Kruskal-Wallis test: <i>Chi² values with ties (italic)</i>		
		1	2	3	4		Overall	Binomial testing (Y = significant)
	n	76	77	77	77	307		
	%	24.7%	25.1%	25.1%	25.1%			
Total business experience (years)	Mean	10.3	13.2	16.7	22.3	15.6	<i>162.2***</i>	
	Std. dev	4.1	4.1	2.9	4.0	5.9		
	Median	9.3	12.6	16.4	21.4	15.4		
TISCE (years)	Mean	4.3	8.1	12.0	18.4	10.7	<i>258.0***</i>	
	Std. dev	1.4	1.1	1.3	3.4	5.6		
	Median	4.0	8.0	12.0	17.0	10.0		
TISCE by function	Business strategy	0.9%	3.8%	2.9%	5.2%	3.8%	<i>6.2*</i>	
	Consulting	10.4%	16.3%	13.8%	2.7%	9.2%	<i>13.8***</i>	
	Controlling/finance	3.7%	2.9%	2.8%	5.2%	3.9%	<i>0.5</i>	
	IT	3.7%	2.9%	3.9%	3.6%	3.6%	<i>1.2</i>	
	Logistics	14.3%	25.8%	16.3%	18.5%	18.8%	<i>7.51**</i>	
	Procurement	13.1%	4.6%	17.2%	17.4%	14.5%	<i>3.4</i>	
	Production	7.6%	9.7%	9.8%	14.0%	11.4%	<i>12.26***</i>	
	Project management	7.3%	7.2%	6.6%	5.3%	6.2%	<i>3.3</i>	
	Sales/marketing	9.5%	5.1%	15.9%	14.4%	12.6%	<i>9.21**</i>	
	SCM	23.2%	18.2%	6.9%	9.9%	12.0%	<i>4.4</i>	
	Others	6.4%	3.5%	3.8%	3.9%	4.0%	<i>0.3</i>	
	Current industry	Automotive & parts	14.5%	6.5%	7.7%	10.5%	9.8%	
		Chemicals	5.3%	7.8%	10.3%	11.8%	8.8%	
		Food & beverages	5.3%	7.8%	7.7%	6.6%	6.8%	
Healthcare		9.2%	11.7%	11.5%	11.8%	11.1%		
Industrial goods & services		30.3%**	20.8%	21.8%	15.8%	22.1%	Y	
Personal & household goods		9.2%	9.1%	14.1%	11.8%	11.1%		
Retail		7.9%	5.2%	2.6%	6.6%	5.5%		
Technology		6.6%	14.3%	17.9%	7.9%	11.7%		
Other		11.8%	16.9%	6.4%	17.1%	13.0%		
Industry of first SCE position		Automotive & parts	14.5%	5.2%	10.3%	10.5%	9.9%	
	Chemicals	9.2%	10.4%	11.5%	11.8%	10.6%		
	Food & beverages	2.6%	7.8%	6.4%	6.6%	5.9%		
	Healthcare	10.5%	11.7%	11.5%	11.8%	11.2%		
	Industrial goods & services	30.3%*	22.1%	19.2%	19.7%	23.8%	Y	
	Personal & household goods	7.9%	11.7%	11.5%	11.8%	10.9%		
	Retail	7.9%	5.2%	6.4%	6.6%	5.6%		
	Technology	7.9%	13.0%	7.7%	7.9%	11.6%		
	Other	9.2%	13.0%	10.3%	13.2%	10.6%		
	Starting industry	Automotive & parts	7.9%*	10.4%	10.3%	17.1%	11.4%	Y
Chemicals		5.3%	9.1%	5.1%	6.6%	6.5%		
Food & beverages		6.6%**	6.5%	5.1%	1.3%	4.9%	Y	
Healthcare		6.6%	7.8%	2.6%	9.2%	6.5%		
Industrial goods & services		36.8%	27.3%	30.8%	27.6%	30.6%		
Personal & household goods		6.6%	11.7%	17.9%	10.5%	11.7%		
Retail		6.6%	2.6%	3.8%	10.5%	5.9%		
Technology		11.8%**	10.4%	16.7%	5.3%	11.1%	Y	
Other		11.8%	14.3%	7.7%	11.8%	11.4%		
Company size (revenue in €)		< 1 billion	18.4%	21.9%	21.9%	27.6%	22.5%	
	1-10 bn	50.0%	38.1%	38.1%	38.2%	41.0%		
	> 10 bn	31.6%	40.0%	40.0%	34.2%	36.5%		
	% of cluster members who were executives in other function before	%	23.7%***	45.5%	67.9%	69.7%	51.5%	Y
% of TISCE spent as exec. of other dept.	%	20.7%*	24.1%	32.1%	34.8%	30.6%	Y	
% of managers in SCM before	%	34.2%	32.5%	32.1%	25.0%	28.7%		
Years in SCM before SCE	Mean	2.9	4.6	3.6	7.3	0.0		
% of women in cluster	%	6.7%	13.0%	6.4%	9.2%	8.8%		
Cohorts n=	21+ years of experience	2**	7	10	49	68	Y	
	11-20	31	51	68	27	177		
	<=10	43***	19	0	0	62	Y	
Level of education	Apprenticeship	4.2%***	4.1%	4.1%	22.4%	8.4%	Y	
	Undergraduate	5.6%	0.0%	1.4%	3.0%	2.5%		
	Graduate	78.9%	85.1%	86.3%	68.7%	80.0%		
	Ph.D.	11.3%***	10.8%	4.1%	3.0%	7.4%	Y	
	Others	0.0%	0.0%	4.1%	3.0%	1.8%		
Field of studies	Business & economics	51.4%	39.7%	43.5%	41.9%	44.2%		
	Industrial engineering	11.4%	20.5%	17.4%	6.5%	14.2%		
	Engineering	15.7%*	15.1%	20.3%	25.8%	19.0%	Y	
	Computer science	2.9%	0.0%	4.3%	1.6%	2.2%		
	Logistics	8.6%	11.0%	2.9%	4.8%	6.9%		
	Natural sciences	4.3%	5.5%	2.9%	1.6%	3.6%		
Others	5.7%**	8.2%	8.7%	17.7%	9.9%	Y		

Significance level *** = p < 0.001 ** = p < 0.01 * = p < 0.05
 Kruskal-Wallis test Measures whether there is a statistically significant difference among the cluster values
 Binomial testing Significance testing based on comparison between cluster 1 and cluster 4 values
 E.g. 11.3%*** in cluster 1 means that this value is significantly different from 7.4% in cluster 4 at least at a p < 0.001 level

In contrast to the OMA six-cluster solution, we found significant differences among the industries: technology and food & beverages appear to enable faster career advancement, while automotive & parts, with more Laggards, seems to be a more challenging environment. Comparably high shares of Leaders and Laggards begin their careers in industrial goods & services (36.8% vs. 27.6%, respectively). However, it appears that Leaders remain in this industry and work their way up, whereas many Laggards move to other industries.

A total of 69.7% of the Laggards had held previous executive positions, compared with only 23.7% of the Leaders. This result suggests that most of the Laggards were career changers. Educational background also appears to play a role. Significantly fewer of the Leaders have engineering backgrounds, and there are fewer graduates from non-related fields of study. Moreover, Leaders hold more degrees: 11.3% hold a Ph.D. and only 4.2% began their careers in apprenticeship positions, whereas 22.4% of the Laggards worked their way up after an apprenticeship. Overall, both a degree in a field of study that is related to business or logistics and an early focus on SCM or consulting in one of the three highlighted industries appear to support a rapidly rising SCM career.

TABLE 3-7: COMPARISON OF OMA AND CAREER SLOPE CLUSTERS

		Leaders	2nd quartile	3rd quartile	Laggards	
Demand-siders	1	2.7%	8.1%	51.4%	37.8%	100%
Homegrowns	2	40.6%	29.7%	12.5%	17.2%	100%
Logisticians	3	24.0%	25.0%	24.0%	26.9%	100%
Sourcing Specialists	4	0.0%	5.3%	63.2%	31.6%	100%
Operations Experts	5	19.2%	26.9%	30.8%	23.1%	100%
Outsiders	6	33.3%	36.8%	7.0%	22.8%	100%

Table 3-7 provides a comparison matrix of both cluster solutions. Interestingly, only 2.7% of the Demand-siders and none of the Sourcing Specialists are among the Leaders. However, 40.6% of

the Homegrowns and 33.3% of the Outsiders are in the Leaders cluster. In contrast, only 7.0% of the Outsiders belong to the slowest quartile in terms of career slope, while the majority of the Demand-siders (51.3%) and Sourcing Specialists (63.2%) do belong to it. The findings from this comparison are in line with the TtSCE metric of the OMA six-cluster solution, i.e., that Homegrowns and Outsiders appear to have the best chances for rapid career advancement in SCM.

3.6 Conclusion

This exploratory study aims to elucidate the career paths and educational backgrounds of supply chain executives based on a unique dataset of 307 individuals working in Germany, Austria and Switzerland. To the best of our knowledge, we are the first team to address this topic in SCM research.

3.6.1 Contribution to the Literature

This paper provides several contributions to the literature. By applying an interdisciplinary approach linking career theory and sociology to SCM research, we respond to the suggestion that this type of research is required for tackling contemporary supply chain problems (Sanders & Wagner, 2011; Sanders, Fugate & Zacharia, 2016). Simultaneously, we answer recent calls for more research on the “people dimension” in supply chains (Wieland, Handfield & Durach, 2016). Our findings suggest that the cross-functional nature and complexity of the supply chain function is mirrored in the diversity of the SCEs’ professional experience, thus extending the previous literature that explains SCM’s overarching orientation conceptually from a process perspective but neglects the people side (Cooper, Lambert & Pagh, 1997; Mentzer, Stank & Esper, 2008). The number of publications on SCEs has increased only recently. Three papers have studied the presence of SCEs in corporate upper echelons (Wagner & Kemmerling, 2014) and the performance effects, choices and consequences of CSCO appointments (Hendricks, Hora & Singhal, 2014; Roh, Krause & Swink, 2016). These papers have contributed to the understanding

of executive *roles* as formal positions in organizations. This paper complements those studies by pinpointing the diversity of the individuals who fill SCE roles, giving them faces.

In the process, our study helps to bridge the gap between HRM and SCM research. So far, both fields have provided potentially promising – yet incomplete – perspectives on the people in supply chains (Fisher et al., 2010). Although a sizeable stream of literature on interpersonal relationships across functions and organizations exists (e.g., Hult, Ketchen Jr. & Slater, 2004), this work rarely delves into human resource topics (Fisher et al., 2010). The limited work on HRM topics has primarily focused on studying the demands on various SCM employee groups, i.e., which competencies and profiles they need to or should possess to qualify for a job (Hohenstein, Feisel & Hartmann, 2014). This study’s insights, on the other hand, add to the body of knowledge by describing the educational background and professional experience they actually have to offer.

Our findings also provide further support for the boundaryless career theory. With the exception of the “Homegrown” cluster, SCE career patterns show movement through various functions, industries and employers, indicating that careers change constantly. However, our data do not contain information on the motivations for career rearrangement. The initiator for career changes in SCM would be an interesting topic for further research.

Boundaryless career paths have implications for universities, colleges and vocational schools. Educational institutions must equip their students with a broad toolkit of knowledge and skills that enable them to master several jobs throughout their early career rather than preparing them for one specific type of job or a lifelong employer-employee relationship.

Finally, we introduce OMA to our academic field as a research methodology. Although OMA belongs to the family of sequence analysis methods and is most often used for career or life course pattern analyses, it can also be used to investigate other SCM research problems such as small-

group analyses, time-budget studies and innovation process analyses in the future (for an excellent review of the potential applications of OMA, see Abbott & Tsay, 2000).

3.6.2 Practical Contribution

Our findings contribute to employer workforce planning and career path architecture for individuals. These insights into individuals' backgrounds and their diversity can assist HRM departments in making multiple decisions. Employers need to manage succession planning, improve their recruitment, and design training programs according to the heterogeneous backgrounds of their SCEs (John, 2015). In this context, our six-career-pattern scheme could be adopted as a workforce planning and development framework for categorizing SCM personnel based on their background. For example, "Demand-siders," who have prior staff responsibilities but limited exposure to SCM activities, could benefit from training in the core SCM concepts and competencies, while "Homegrowns," who have extensive SCM knowledge but limited outside knowledge, could receive training in leadership and general management. Moreover, our findings have important implications for future hiring decisions. HRM will be able to build the SCM function with staff from different patterns. The function could benefit from diverse educational backgrounds, practical knowledge and experience. In conclusion, our insights can help companies establish congruence between individuals' competencies and work environment requirements to facilitate performance-related success (Betz, Fitzgerald & Hill, 1989).

For ambitious members of the SCM community, particularly the young cohort, we highlight key strategies for accelerating their career trajectories. For instance, gaining experience in consulting is positively associated with rapid promotions. Three industries in particular (technology, food & beverages and industrial goods & services) facilitate rapid career advancement, whereas it is more difficult to progress in the competitive automotive & parts industry. A graduate degree or a Ph.D. in a business-relevant field also drives rapid success, whereas former apprenticeship students and

graduates with degrees in engineering and “exotic” fields of study usually have a flatter career slope. Moreover, the young generation has the opportunity to move straight into the “Homegrown” career track, which did not exist in the same form decades ago. However, the differences in the six career patterns also suggest that SCM is an excellent target for lateral hires, as its cross-functional nature leaves the door open for people from other functions. In particular, previous staff responsibility appears to be a core competency for becoming an SCE.

3.6.3 Limitations and Future Research

Our research also has certain limitations. The application of OMA requires some simplifying assumptions. We were forced to focus on functional career paths only, thus neglecting hierarchical levels and industries in the OMA. Furthermore, as in many previous career pattern studies, “the assignment of transformation costs haunts all optimal matching analyses” (Stovel, Savage & Bearman, 1996). As a sensitivity analysis, we performed the OMA with all substitution cost rates set to unity. The results stayed relatively stable: the cluster sizes were almost equal, and the same similar career paths constituted the cores of the clusters as before. However, some career paths that exhibited the traits of several clusters moved to other clusters. This result is not surprising and in fact, highlights the importance of thoroughly developing rational cost rates in the first place. Due to our selection of XING as a data source, we limited our data to SCEs from German-speaking countries. Moreover, the available data do not allow further differentiation based on academic performance – neither GPA nor graduation with honors – which could influence individuals’ career progression and they do not show differences in performance on the job between clusters. There are multiple avenues for future research. Future studies could investigate managers who launched their careers in SCM and subsequently obtained executive positions in other functions. These studies could investigate whether the extraordinary responsibilities and experience associated with an SCM position enhance professionals’ attractiveness in other departments.

Additionally, researchers could conduct surveys to gain insights into the impact of the “soft factors” that influence a management career and cannot be extracted from professional resumes (motivation for job changes, career goals and subjective career success measures). Future studies could contribute to career theory by empirically testing whether career changes in supply chain management are self-directed, opportunity-driven or initiated by employers. Finally, our study investigates the “supply side” of SCEs. The data show us what these executives have to offer to companies. Another avenue for future research would be to study the “demand side:” what companies expect from their SCEs in the future and how they meet those requirements.

4 Competency Requirements and Selection Criteria of Supply Chain Planners and Analysts

Abstract

This study aims to enhance the understanding of competency requirements of supply chain planners and analysts and to identify and distinguish between the types of managers that make employee selections. An adaptive choice-based conjoint experiment was used to uncover the relative importance of six competency attributes, namely *analytical & problem-solving ability*, *interpersonal skills*, *general management skills*, *computer/IT skills*, *SCM knowledge*, and *industry experience*. A total of 243 participants with hiring experience participated in a two-phase experimental design to make complex trade-off decisions between hypothetical job candidates. *SCM knowledge* and *analytical & problem-solving ability* were identified as the most important competencies, and were considered three times more important than *general management skills*. Based on convergent cluster and ensemble analysis, two types of hiring managers were identified. The first group is characterized by a pronounced preference for job candidates with extensive SCM knowledge. In contrast, the second group's members prefer candidates with a more balanced competency profile.

Keywords: Human Resources, Employee Selection, Supply Chain Management, Experiment, Conjoint Analysis, Knowledge, Skills & Abilities

4.1 Introduction

Having employees whose competencies fit the demands of their job is an essential criteria for company success. This need is reflected in the human resources literature, which suggests that highly-skilled employees can be a strategic resource that facilitate a firm's competitive advantage (Wright, McMahan & McWilliams, 1994; Wright, Dunford & Snell, 2001). However, an essential pre-requisite to facilitating the strategic use of human resources is finding congruence between employee competencies, job requirements, and the organizational environment—only then can the employee's personal job satisfaction and the employer's performance satisfaction be achieved (Betz, Fitzgerald & Hill, 1989). Consequently, placing the right people with the right competencies in the right position is a key success determinant of human resource management (HRM). Accomplishing this task is particularly challenging for supply chain management (SCM) positions (Gattorna, 2006). SCM is a profession that demands an extraordinary combination of competencies, since it links numerous functions within and across companies (Lambert & Cooper, 2000) and manages multiple flows (e.g., physical, financial, and information) to create value for suppliers, manufacturers, and customers (Mentzer, DeWitt & Keebler, 2001). Moreover, since SCM has evolved into a strategic function only recently (Hult, Ketchen Jr. & Arrfelt, 2007), demands on supply chain personnel have changed (Fisher et al., 2010). The increasing complexity of today's business environments is characterized by shorter product life cycles, global supplier networks, outsourcing, and foreign market entrances, which has led to ever-increasing competency requirements for supply chain personnel (Slone, Mentzer & Dittmann, 2007). At the same time, those factors combined with ongoing baby boomer retirements have led to a serious shortage of supply chain talent (Cottrill, 2010; Ruamsook & Craighead, 2014). In fact, recruitment, retention, and succession planning are among the major challenges in SCM, in particular because firms and HRM professionals lack understanding of supply chain talent and their requirements (John, 2015). In response, improving the understanding of crucial SCM

competencies would be mutually beneficial for employers and employees as it would increase the likelihood of matching job-related competencies and requirements.

Despite the fact that HRM has rarely been represented in the SCM and related literature compared to other research streams, individual competencies have been the scope of the majority of HRM-related studies (Hohenstein, Feisel & Hartmann, 2014). These individual competencies have been defined as the combination of knowledge, skills, and abilities (KSAs) that are associated with high individual job performance (Mirabile, 1997; Barnes & Liao, 2012). The literature has primarily focused on studying the importance of competencies for various SCM employee groups. Researchers have studied the skills of senior logistics managers (Murphy & Poist, 1991, 1998, 2006, 2007; Razaque & Sirat, 2001) entry-level logistics personnel (Gibson & Cook, 2003; Murphy & Poist, 2006), supply chain managers (Gammelgaard & Larson, 2001; Mangan & Christopher, 2005), humanitarian logisticians (Kovács, Tatham & Larson, 2012), procurement managers (Giunipero, Dawley & Anthony, 1999; Giunipero & Percy, 2000; Carr & Smeltzer, 2000) and, more generally, human capital development in logistics (Myers et al., 2004).

At the same time, no paper has yet focused on the competency requirements of supply chain planners and analysts (SCP&As), even though planning, analyzing, and optimizing inventory levels, purchasing volumes, and distribution processes are key activities of SCM personnel. In fact, planning was recently voted the most important activity for supply chains by over 1,000 Chief Supply Chain Officers (O'Marah et al., 2014). In particular, integrated sales and operations planning was rated as the top skill, since it can be regarded as the most fundamental practice for balancing supply and demand in any supply chain organization regardless of size, country, or industry. Moreover, the Chief Supply Chain Officers indicated that higher demand volatility and rising customer expectations of supply chain agility have dramatically increased the uncertainty in sales and operations planning and increased pressure on better forecast accuracy

(O'Marah et al., 2014). Simultaneously, many sales and operations planning teams struggle to digest the exploding quantity of demand data that could potentially help them cope with the higher customer expectations.

The overarching premise of this empirical study can be formulated with two distinct research questions that will be developed more thoroughly hereafter:

RQ 1: What are the key competency requirements of supply chain planners & analysts?

RQ 2: What are managers' and firms' preferences when selecting job candidates and are they sufficiently distinct to enable segmentation?

To address these two research questions, adaptive choice-based conjoint (ACBC) analysis was borrowed from marketing research. This experimental research method is frequently used to observe consumer preferences for products and services. Compared to the conventional survey methods usually applied to assessing the importance of various competencies in SCM, ACBC analysis embodies two superior features. First, ACBC analysis forces participants to make complex trade-off decisions between the study's attributes (in this case competencies), such that competencies are ranked according to their relative importance instead of being treated as independent items in a questionnaire (Green, Krieger & Wind, 2001). Simultaneously, ACBC analysis captures information on the preferences of the experiment's participants by uncovering their individual utility functions toward the attributes. As a result, participants can be segmented according to their choices to distinguish between heterogeneous types of hiring managers.

To meet the research objectives, an extensive literature review drawing from the knowledge-based view (KBV) of the firm was used to develop the conceptual background for this study. Subsequently, based on a meta-analysis of the literature on supply chain competencies and an empirical assessment of 200 current online SCM job advertisements, six essential competencies

of SCP&As were identified. An ACBC experiment was conducted with 243 managers possessing experience in SCM employee selection based in Europe, most notably Germany, to collect the data. Hereby, participants were confronted with a hypothetical hiring situation in which they had to select the best qualified job candidates based on six competency attributes. Ultimately, the true determinants of employee selection in SCM were revealed, extending the previous literature.

Section 4.2 develops the conceptual background to position the paper within the existing literature. Section 4.3 presents the key SCP&A competencies used in the experiment and the process for developing them. Section 4.4 describes the research methodologies, experimental design, and sampling process. Section 4.5 presents the analyses and reveals the results. Section 4.6 discusses insights and contextualizes them with regard to the previous knowledge. Finally, section 4.7 concludes the paper and provides an outlook on future research opportunities.

4.2 Conceptual Background and Literature Review

This section serves three purposes. First, it provides an overview of the relevant literature in the management, human resource, and SCM research. Second, it provides useful definitions and links the manifold concepts together. Third, it elaborates on the posed research questions to outline the relevance of this research.

4.2.1 Human Resources and the Competitive Advantage of a Firm

The quest to select highly-competent supply chain personnel is grounded in the knowledge-based view (KBV) of the firm. The KBV is based on the idea that knowledge can be a source of competitive advantage for a firm (Grant, 1996; Kogut & Zander, 1992). Research suggests that such strategic knowledge can reside within individuals, i.e., personnel (Simon, 1991; Grant, 1996). More specifically, individuals embody KSAs that they apply at their job and place at the disposal of their employer. Such competencies, however, only qualify as a source of competitive

advantage if they meet four criteria (Barney, 1991): They must be valuable, rare, inimitable, and non-substitutable. The HRM literature suggests that those criteria can be fulfilled by capable human resources. First, the economic literature argues that human resources provide value to their firm (Pfeffer, 1994). They allocate their competencies and time to create value through products and services. Second, capable labor is rare. Studies have suggested that KSAs are normally distributed in the population (Wright, McMahan & McWilliams, 1994). Exceptionally qualified employees are therefore—by definition—rare (Wright & McMahan, 1992). Third, it is very difficult to imitate highly-skilled workers. The inimitability of human resources can be explained by the principles of causal ambiguity, social complexity, and tacit knowledge. Causal ambiguity exists when the link between a firm's competitive advantage and its resources are imperfectly understood (Reed & Defillippi, 1990). In other words, competitors are hard-pressed to understand which key personnel are responsible for the competitive advantage and how they act to achieve this advantage; this lack of observability makes imitation very difficult. Social complexity refers to the phenomenon that social interactions between human resources are so complex that it is impossible to manage or influence them systematically, for instance, through imitation (Wright, McMahan & McWilliams, 1994). Often, knowledge creation in a department is heavily driven through interaction and the unique combination of its member's competencies. A firm's attempt to imitate a competitor's team with their own employees has a low likelihood of success. Tacit knowledge refers to one of the fundamental principles of the KBV of the firm (Kogut & Zander, 1992; Grant, 1996). A substantial share of human resource's competency is tacit or implicit. More specifically, this type of knowledge is subjective and difficult to conceptualize. It can be referred to as *knowing more than we can tell* or *knowing how to do something without thinking about it* (Polanyi, 1966), which makes imitation by or transfer to competitors difficult. Fourth, even in light of technical advancements human resources are non-substitutable; indeed, only some of their tasks can be substituted. For instance, if you consider cognitive ability to be a relevant

competency, this ability is generalizable and applicable to numerous jobs in SCM. Accordingly, an employee can transfer this ability to new assignments, even if the previous task was substituted by a technological innovation (Wright, McMahan & McWilliams, 1994). In fact, despite consistent technological advancements that have led to labor-saving processes and automation, the shift toward a service economy has made human resource substitution less likely (Wright, McMahan & McWilliams, 1994; Huselid, 1995).

For the given reasons, HRM should place great emphasis on recruiting and developing top talent, as proficient employees have consistently been linked to organizational and SCM-related performance (Snell & Dean, Jr., 1992; Youndt et al., 1996; Becker & Gerhart, 1996).

4.2.2 Competencies and Employee Selection to Facilitate Person-Job Fit

Finding capable human resources is a necessary but not sufficient criteria for successful HRM practices. More specifically, firms must facilitate congruence between a person's competencies and a job's demands, which is conceptualized as "person-job fit" (Caldwell & O'Reilly III, 1990). Person-job fit has been positively associated with job performance and job satisfaction (Caldwell & O'Reilly III, 1990). Accordingly, the employee selection practices of most organizations focus on achieving person-job fit (Werbel & Gilliland, 1999). A central element of facilitating this match is the identification of job demands in order to enable recruiters to find the job prospect with the best match. Consequently, a fair share of HRM studies in SCM and logistics have focused on identifying and classifying the most important competencies and recognized it as key factor in human resource selection (Hohenstein, Feisel & Hartmann, 2014; Gatewood, Feild & Barrick, 2016).

In a series of research papers, Murphy and Poist (1991; 1998; 2006; 2007) distinguished the business, logistics, and management (BLM) skills of entry-level and senior-level logisticians.

Their original BLM framework consists of 83 individual skills and knowledge items: 33 business, 18 logistics, and 32 management skills. In their 2007 study, Murphy and Poist found both consistency and changes compared to the initial survey (1991), and stressed that competencies requirements should be studied regularly to capture changes in demands. Nevertheless, they reinforced their previous statement that “a contemporary logistician should be manager first, and a logistician second” (Murphy & Poist, 2007, p. 430). In a multi-method study relying on surveys and case studies, Gammelgaard and Larson (2001) studied the skills of logistics and supply chain managers. Based on an exploratory factor analysis they grouped 45 skills items as “managerial skills,” “SCM core skills,” and “quantitative/technical skills.”

These studies, among others, all relied on survey methods that suffer from the methodological shortfalls that arise naturally in such a research setting: a promising SCM professional has to be reasonably skilled in every dimension to fulfill his duty. As a result, almost all competency items surveyed are rated as either *important* or *very important*. In other words, the spectrum of a typical Likert-scale is not fully utilized, because all answers occur in the upper units of the scale. For example, in Giunipero & Percy's (2000) paper the mean of the top- and median-ranked purchasing skill (out of 30) differed by only 0.50 points on a 5-point Likert scale. Hence, in many cases there is no statistically significant difference between the item means, which leaves scant room for meaningful interpretation. Moreover, a Likert-scaled survey only measures absolute importance, studying each item in an isolated state. However, as it is unlikely that all KSAs are really equally important, relative importance ratings should play a more prominent role in determining essential job requirements (Gatewood, Feild & Barrick, 2016).

When examining the specific competency items that have been researched in the SCM literature, one can observe that the focus has clearly been placed on skills and abilities rather than knowledge or experience (e.g., see BLM framework by Murphy & Poist, 1991). This focus suggests that, in

general, skills and abilities are perceived to be more important than fact-based knowledge in the SCM context. Moreover, we know from the literature that it is more difficult to acquire skills and abilities than fact-based knowledge (Nass, 1994). In conclusion, it will be insightful to observe whether this trend remains if knowledge, skills, and abilities are studied in relation to one another.

Recruitment, selection, and hiring have been subject to a very limited number of studies in the SCM literature (Hohenstein, Feisel & Hartmann, 2014). Among this small sample of papers, no study aims to cover which competencies drive employee selection in SCM through an experimental approach. Rather, previous research tries to investigate recruitment and hiring practices and their efficiency in generating large pools of qualified candidates. Gibson and Cook (2003) surveyed logistics firms and logistics graduates to understand whether both groups had a mutual understanding of the requirements of entry-level logistics job positions. Inter alia, employers rank the importance of items in candidate resumes. The students' predictions of employer preferences were relatively accurate, indicating mutual understanding of job requirements. In a study on the hiring practices of U.S. third-party logistics providers, the same skill categories were identified as drivers when selecting job candidates for a logistics position (Gibson & Cook, 2001). Myers et al. (2004) highlighted identifying the best-fitting candidates for various SCM positions as the key challenge for international corporations. Also, companies must decide whether they want to follow the strategy of acquiring competencies (hiring) or developing them (training), and Myers et al. argue that identifying competent job prospects is of strategic importance for companies. This is in line with Slone, Mentzer and Dittmann (2007) who point out that only the best supply chain talent should be hired, and that new hires should be reviewed at all hierarchical levels, including lower ranks.

As no study has yet focused on the preferences of firms and managers when making employee selection decisions or whether heterogeneity exists among decision makers' preferences, this paper explores these topics.

4.3 Identification of Key Competency Attributes

Developing the key competency attributes that ultimately qualify for the final experiment is one of the toughest choices when designing conjoint experiments (Rao, 2014; Orme, 2002). Thus, this section describes the dual process used to identify the key competency categories. A literature review and empirical approach were used.

4.3.1 Meta-Analysis of Key Competencies in Supply Chain Management Context

Hohenstein, Feisel and Hartmann's (2014) recent extensive literature review on HRM issues in SCM was used as the basis for exploring the key competencies of SCM personnel that could be used to design the ACBC experiment. The competencies of SCM personnel and related functions (i.e., logistics, operations, and procurement) have been the subject of academic studies. To identify the most important competency items from the literature, six studies (Murphy & Poist, 1991, 1998, 2006, 2007; Giunipero & Percy, 2000; Gammelgaard & Larson, 2001) were analyzed and compared. Those studies all used comparable question items and scales to survey SCM professionals, thereby enabling aggregated meta-analysis. Extracting all items led to a list of 269 KSA items. This list was then condensed using a three-step process. First, items were classified and standardized, as the authors used slightly different wording for the same competencies. Second, as the studies also used different scales, the means of all items were normalized to a 5-point Likert scale (1 = *not important at all*, 5 = *very important*). After those two steps, a short list of 90 competency items emerged. Table 4-1 provides an overview of the first quartile (i.e., the top 25% of all items on the short list that scored the highest means across all studies). As conjoint experiments can usually only accommodate six or fewer attributes (Orme,

2002), the first quartile should be sufficient for identifying the most important competencies. As the final condensation step, the competency items were classified by applying the framework proposed by Mangan and Christopher (2005) and adapted by Kovács, Tatham and Larson (2012). The framework suggests using four categories: functional expertise, general management skills, interpersonal skills, and analytical & problem-solving ability. Those categories also comply with the idea of the KSA framework. Functional expertise can be considered *knowledge* of the function, while analytical & problem solving ability falls under individual *abilities*. The other categories can be summarized as *skills*, the broadest categories that was also subject to the largest number of empirical studies (e.g., Murphy & Poist, 1991; Gammelgaard & Larson, 2001).

TABLE 4-1: META-ANALYSIS: TOP 25% COMPETENCY ITEMS IN THE LITERATURE

Rank	Competency	Category	Aggregated mean (scale: 1-5)
1	Personal integrity	Interpersonal skills	4.767
2	Motivating others	Interpersonal skills	4.747
3	Organization and planning	General management skills	4.653
4	Self-motivation	Analytical & problem-solving ability	4.597
5	Managerial control	General management skills	4.563
6	Persuasion	Interpersonal skills	4.553
7	Change management	General management skills	4.543
8	Delegate responsibility	Interpersonal skills	4.537
9	Problem-solving ability	Analytical & problem-solving ability	4.531
10	Customer service	General management skills	4.530
11	Supervision	Interpersonal skills	4.523
12	Negotiation	General management skills	4.510
13	Expertise in interpersonal relations	Interpersonal skills	4.510
13	Transportation & Logistics	Functional expertise	4.498
15	Self-confidence	Analytical & problem-solving ability	4.493
16	Strategic thinking	General management skills	4.470
17	Viewing a firm as a system	Analytical & problem-solving ability	4.467
18	Effective communication	Interpersonal skills	4.443
19	Conflict resolution	Analytical & problem-solving ability	4.440
20	Listening	Interpersonal skills	4.387
21	Decision-making	Analytical & problem-solving ability	4.354
22	Enthusiasm	Analytical & problem-solving ability	4.343
23	Analytical	Analytical & problem-solving ability	4.330

Scale: 1 = unimportant, 5 = very important

To ensure high reliability and minimize subjectivity in the categorization process, this process was repeated independently by a second researcher who was familiar with the research topic. The categorizations of both researchers were compared by calculating Cohen's Kappa, a statistical measure for inter-rater agreement and reliability (Cohen, 1960; Grayson & Rust, 2001). In this case $\kappa = 0.81$ was obtained, which indicates almost perfect inter-rater agreement between both researchers (Landis & Koch, 1977) and, therefore, diminishes the possible threat of subjectivity in the categorization process.

4.3.2 Empirical Identification of Job Requirements of Supply Chain Planners and Analysts

An empirical evaluation of the job requirements of SCP&As complemented the literature review. Pursuing a dual process should increase the likelihood that the attributes selected for the study cover most of the essential competency dimensions that determine SCP&A selection. Moreover, due to rapid advancements in SCM, an empirical evaluation of current job requirements ensures the relevance of the competencies included in the ACBC experiment. Job advertisements (JAs) were considered a source of information for what companies demand from potential employees. Similar to the approach used by Rossetti and Dooley (2010), the job platforms Monster.com and Monster.co.uk were used to gather JAs for SCP&As. Monster.com is known to have the highest hit rate for job searchers (Bakker, Demerouti & Verbeke, 2004) and has been repeatedly used for empirical studies addressing various job characteristics (Rossetti & Dooley, 2010; Feldman & Klaas, 2002).

SCP&As were combined into one associated employee group ex-post after the JA analysis, because JA for supply chain planners and supply chain analysts matched by 98%. More precisely, the content posted in the JAs was almost identical for both job positions, suggesting that equal

competencies are needed for both jobs. The search words “supply chain planner,” “inventory planner,” “demand planner,” and “supply chain analyst” were used to find appropriate JAs. JAs were only considered and downloaded if the title contained any of the search terms in full, whereby the order of words did not matter. In the case where a JA was posted under multiple titles, the doubles were eliminated from the sample. Also confidential JAs requiring formal requests, JAs leading to external websites, and ones that did not list any competency requirements were not considered, as they were incompatible with the standard advertisement structure of a monster.com JA. Following this approach, 200 qualifying JAs were downloaded.

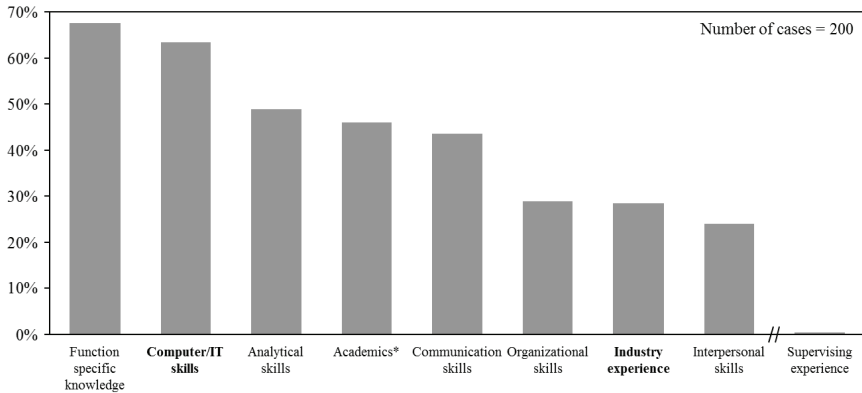
To count the frequency of posted job requirements, a cluster retrieval approach was used. Hereby, entire sentences mentioning identical competencies with equal or slightly different wording were grouped into similar clusters. Those clusters became the basis of a competency and requirements list, which contained the most relevant KSAs and requirements found in the JA.

Figure 4-1 shows the frequency of competencies derived from the JAs. Interestingly, they diverge from the key competencies in the literature. Function-specific experience, computer/IT skills, and analytical skills are the three most-frequently advertised competency requirements. Computer/IT skills were not featured in the first quartile of the meta-analysis, functional knowledge was only represented by one item, and analytical skills were only listed in the twenty-third position. Moreover, industry experience did not emerge from the meta-analysis. The other items shown in Figure 2 match the items obtained from the literature.

The disparity between the data obtained from the literature and the primary data collected only recently (2016) may be due to several reasons. As supply chain complexity has increased constantly in recent years, the demands on people managing supply chains have changed (Ellinger & Ellinger, 2014). Information exchange, big data analysis, demand forecasting, among others,

are centerpieces in today’s SCM activities, all of which require a thorough understanding of information systems and computer software (Fawcett et al., 2011). Due to higher supply chain complexity, functional experience has also become more important; managers need to possess functional understanding in both breadth and depth to overlook manifold aspects end-to-end. In response, companies have recognized the higher demand for computer/IT proficiency and function-specific knowledge and adjusted their JA accordingly.

FIGURE 4-1: SHARE OF KEY JOB REQUIREMENTS FEATURED IN ONLINE JOB ADVERTISEMENTS



NOTE: Competencies in **bold** did not emerge from in the meta-analysis, i.e. they reflect a deviation between academic studies and company JA postings. The other items were represented in the literature as well. *Academics was not considered for the experiment as it represents education rather than a competency

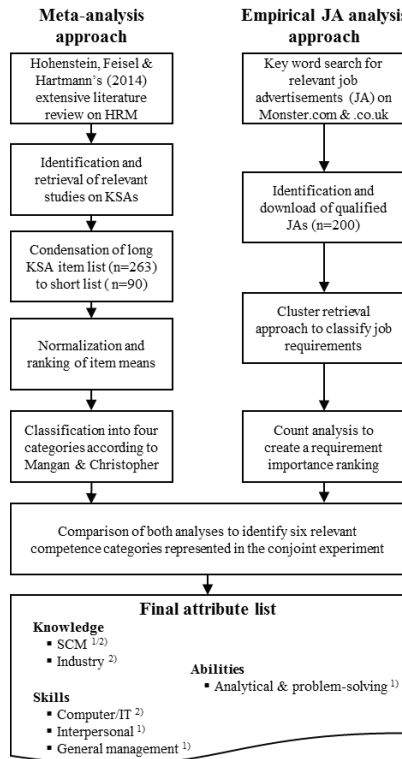
4.3.3 Final Composition of Study Attributes and Levels

We used a consensus solution of the meta-analysis and empirical JA analysis to create the final attributes. First, the four competency categories proposed by Mangan and Christopher (2005) and adopted by Kovács, Tatham and Larson (2012) were used in the ACBC experiment as the competency item lists of the meta-analysis (Table 4-1) supported the notion that this framework adequately covers the spectrum of the most important competencies. Second, those four

competencies were supplemented with the two competencies that emerged from the JAs that were not featured in the top quartile of the meta-analysis, i.e., computer/IT skills and industry experience. Computer/IT skills were the second-most mentioned skills among the JAs and deserve attention in the light of the recent technological advancements within SCM. Industry experience was the qualification mentioned second-most among the competencies that were not featured in the literature. Accordingly, it represents an interesting addition to Mangan and Christopher's framework. Additionally, it increases the number of attributes in the "knowledge" category of KSAs, further distinguishing this study from the ones that focused on "skills" (e.g., Murphy & Poist, 1991). Figure 4-2 visualizes the dual process to identify the six attributes. Their definition and selection of the levels they can adopt is described hereafter.

Analytical & problem-solving abilities refer to data analysis, conceptualization, number affinity, and information gathering. *Computer/IT skills* comprise proficiency in Excel, PowerPoint, SAP, ERP, and database tools. *General management skills* refer to project management, supplier/customer relationships, and risk management. *Interpersonal skills* consist of communication abilities (e.g., listening, verbal, and written), people management, and negotiation. *SCM knowledge* refers to knowledge in inventory management, logistics network design, as well as sales and operations planning. *Industry experience* is defined as previous employment in the same company or business unit; previous employment at a direct supplier, customer, or competitor; or a comparable previous relationship to the industry of the respondent's current employer.

FIGURE 4-2: METHODOLOGICAL DUAL PROCESS TO IDENTIFY KEY COMPETENCIES



Note: 1) emerged from meta-analysis, 2) emerged from empirical JA analysis

For the attributes level, scales comprising three levels each were developed. An identical number of levels across all attributes was chosen to avoid number-of-levels bias, which refers to a respondent's misperception that attributes with more levels are more important than ones with fewer levels (Wittink, Krishnamurthi & Reibstein, 1990; Wittink et al., 1992). During the experiment, skills and abilities were rated as one of three levels: "very good," "good," and "basic." Hereby, we chose a positive scale, e.g., by neglecting any level lower than "basic," as such

candidates would be disqualified for the job as indicated by previous study results indicating that SCM personnel requirements are very demanding (see, e.g., Gammelgaard & Larson, 2001; Murphy & Poist, 2007). Moreover, levels should only cover the real-life spectrum of preferences and, thus, unacceptable levels can be ignored (Orme, 2002). SCM knowledge and industry experience were expressed on the levels “extensive,” “some,” and “none.” In contrast to the skills and ability attributes where some degree of skills or ability had to be present, no functional knowledge might be a realistic scenario for junior planners and analysts who apply straight after graduating university. Accordingly, industry experience might only be an essential requirement in industries with extraordinary product specifications.

Figure 4-3 shows attribute and level descriptions, as well as examples provided to survey participants to ensure a mutual understanding of the study elements.

FIGURE 4-3: SIX COMPETENCY ATTRIBUTES WITH LEVELS AS SHOWN TO THE PARTICIPANTS

Attributes	Levels	Examples
<i>Analytical and problem-solving abilities</i>	Very good	<p>Very good in the respective category, e.g.,</p> <ul style="list-style-type: none"> ▪ Interpersonal skills: very good listener, very strong team player and communicator ▪ Computer /IT skills: outstanding skills in company- and job-relevant software packages ▪ ...
	Good	<p>Good in the respective category, e.g.,</p> <ul style="list-style-type: none"> ▪ General management skills: good project manager, good sense of financial metrics ▪ Analytical and problem-solving ability: quick analyzer of large amount of data ▪ ...
<i>General management skills</i>	Basic	<p>Basic in the respective category, e.g.,</p> <ul style="list-style-type: none"> ▪ General management skills: able to manage multiple tasks at the same time ▪ Computer /IT skills: has worked with relevant software packages before ▪ ...
	Extensive	<p>Extensive knowledge/experience, e.g.,</p> <ul style="list-style-type: none"> ▪ Industry experience: several years of working experience in the same industry ▪ ...
<i>Industry experience</i>	Some	<p>Some knowledge/experience, e.g.,</p> <ul style="list-style-type: none"> ▪ SCM knowledge: previous intersections with SCM, or SCM lectures in college ▪ ...
	None	<p>None – no knowledge/experience, e.g.,</p> <ul style="list-style-type: none"> ▪ Industry experience: No prior work in the same or a related industry ▪ ...
<i>SCM knowledge</i>		

4.4 Research Design

This paper uses the ACBC analysis methodology from the marketing field, which requires detailed description for members of the research community unfamiliar with the methodology. The following section will elaborate on the methodology, the experimental design, covariates, as well as the data collection and sampling approach.

4.4.1 Adaptive Choice-Based Conjoint Analysis

ACBC analysis is a technique that uses choice data and incorporates it into an interview experience for the participant. ACBC analysis is one of the newest advancements in traditional conjoint analysis and has been widely used in marketing research since the 1970s (Green, Krieger & Wind, 2001). “Conjoint” originates from “*considered jointly*,” which underscores a major strength of the technique: Instead of surveying items (variables) independently, respondents indicate their preferences while considering all items jointly (Green & Rao, 1971). As a result, this approach can capture complicated trade-offs, in which participants have to make decisions under realistic constraints (Wind et al., 1989). In traditional marketing research, conjoint analysis is used to handle situations in which a decision-maker must deal with several options that vary across multiple attributes (Green, Krieger & Wind, 2001). Hence, it determines consumer preferences toward the attributes of a product or service. More specifically, it uncovers the utility function of the survey respondent toward those attributes and, beyond of that, the partial-utility functions of each attribute. Thereby researchers can estimate the importance of attributes relative to one another and the combination of attributes that yields the highest overall utility for the respondent (McFadden, 1986).

ACBC is an extension of choice-based conjoint (CBC) analysis, which is the conjoint analysis technique most frequently applied in recent years. Its popularity is rooted in CBC analysis’ ability to deal with the complexity of choosing among multiple competitive profiles, each of which can

vary idiosyncratically across attributes and levels (Green, Krieger & Wind, 2001). ACBC utilizes and combines the strengths of CBC with an adaptive learning experience. More specifically, respondents are presented with choice-tasks that were created individually for them based on their own indications during the experiment. The innovative ACBC technique was selected over the more popular CBC approach for three reasons. First, ACBC experiments provide more accurate individual-level responses compared to CBC methods (Toubia, Hauser & Simester, 2004; Yu, Goos & Vandebroek, 2011). In a comparison experiment, the ACBC error rate was 15-25% lower than the error rate of CBC (Chapman et al., 2009). Second, ACBC experiments require fewer respondents and observations than CBC (Toubia, Hauser & Garcia, 2007) because more information is captured from each individual (Orme, 2009). This is especially advantageous in this study, which targets a highly selective set of participants (Jervis, Ennis & Drake, 2012). Third, the customized experimental design (for a detailed elaboration, please see Experimental Design) provides a more engaging experience than traditional CBC (Chapman et al., 2009). Therefore, it reduces the likelihood of fatigue, a major problem in choice experiments and surveys as response precision often declines with repetitive tasks (Savage & Waldman, 2008).

Results and findings gathered on aggregated full-sample data yield many insights, however pooled data can mask the importance of relationships between explanatory attributes due to compensatory effects in heterogeneous samples (Hatten, Schendel & Cooper, 1978). In order to expose such potential relationships on nuanced levels, respondents should be grouped into homogenous clusters based on their preferences. Subsequently, those groups can be analyzed separately at a disaggregated level. As recommended by multiple sources (Orme & Johnson, 2008; Strehl & Ghosh, 2002), convergent cluster and ensemble analysis (CCEA) was applied to the respondents' individual utility functions to identify heterogeneous groups of managers making employee selections.

4.4.2 Experimental Design

The experimental design consisted of three consecutive steps, as shown in Figure 4-4, which will be described in detail in this section.

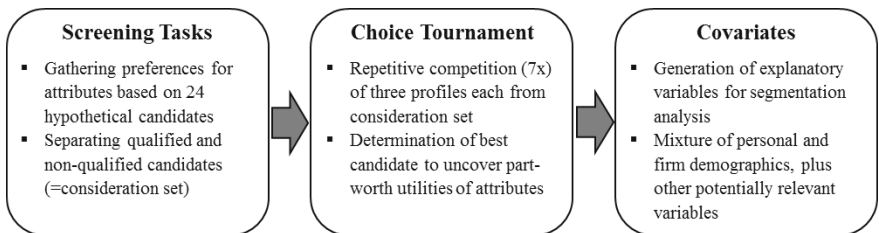
Lighthouse Studio 9 (formerly Sawtooth Software SSI Web) was used to design and execute the ACBC online experiment. The experiment was designed in accordance with the software developers' suggestions. The service possess extensive experience with thousands of choice studies conducted and hosted by their service (Orme, 2010). The ACBC experiment consists of three phases. In the first phase, the experiment starts with six screening tasks: Four candidate profiles featuring one of the three levels for every attribute are presented. Participants must choose whether each candidate is "a possibility" or "won't work for me." Due to these repetitive indications, the software first gathers information about the respondent's preferences. Between screening tasks, two to three "unacceptable" or "must have" questions can appear. Here, participants can indicate whether a certain level is a minimum requirement for them. For example, after candidates with "basic interpersonal skills" were marked as "won't work for me" during the previous screening tasks, the software asks whether "good interpersonal skills" are a minimum requirement. If the respondent offers confirmation, then candidate profiles with less than "good interpersonal skills" won't appear again for the rest of the experiment. Thanks to this logic, the subsequent trade-off decisions are made within the relevant range of levels, which leads to information-rich data generation necessary to expose the respondent's utility function toward attributes and levels.

In the second phase, the screening tasks are followed by a choice tournament. A maximum of 14 candidate profiles that emerged from the screening tasks are brought into the choice tournament. In this phase, three candidate profiles from the screening tasks are shown for each of the seven choice sets. Respondents are now only allowed to select one candidate out of the three. The

selected profile advances to the next choice task, where it faces off against other qualified candidates. Using this repetitive approach, the “ultimate winner” (i.e., the candidate that best meets the respondent’s preferences) is identified. To avoid biases from order effects, the sequence of the choice sets and of the attributes are randomized for every participant.

In the third phase, a conventional questionnaire is used to obtain individual and firm-specific demographics and other variables. Those variables can be used to explain the different group characteristics obtained with the segmentation analysis. The choice of important covariates is described in detail in the following subsection (Covariates).

FIGURE 4-4: ACBC EXPERIMENT DESIGN



The questionnaire was translated from English to German by the author to offer respondents the option of answering in their native language, which has multiple benefits. Studies have shown that the response rates increase, as it is more convenient for participants to answer in their native language (Gibbons, Zellner & Rudek, 1999). Moreover, respondents tend to answer more truthfully in their native language and are more likely to provide responses at the extreme ends of scales, while respondents using a non-native language tend to provide more neutral responses, i.e., they are more likely to select a response in the middle of the scale (Gibbons, Zellner & Rudek, 1999). Finally, native-language questionnaires remove potential sources of misunderstanding that could exist in non-native questionnaires (Harzing, 2006). According to good scientific practice, forward and back translation by two researchers was used to ensure measurement scale equality.

The research design underwent four phases of pre-testing. First, the experiment was simulated with 500 robotic participants, which is a feature integrated into the Lighthouse Studio 9 software. This simulation ensures that the number of choice tasks, the number of attributes, their levels, and the number of level variations across choice-sets is sufficient to ensure that rich and accurate data can be generated from respondents. Based on this design test, the number of screening tasks (six tasks with four profiles each), must have/unacceptable tasks (maximum three and two, respectively), and choice tasks (seven choices with three profiles each) were chosen. Second, the experiment was pre-tested by five PhD students with backgrounds in SCM and marketing to assess the clarity and conciseness of the instructions and assignments, and the visual appearance of the user interface. Third, the experimental design was assessed by two professors who frequently use conjoint analysis in their research. They confirmed the appropriateness and accuracy of the research design. Sample screenshots of the experiment's user interface are provided in Appendix 4-A.

4.4.3 Covariates

In conjoint experiments, covariates are individual-level variables that are collected to help explain observed structures in the data, such as the heterogeneity of respondents (Rao, 2014). For this study, a mixture of covariates was chosen to cover a variety of factors that could potentially describe different types of respondents. First, conventional firm-specific demographics used in most contemporary SCM-related studies were chosen as control covariates, namely firm size (measured in number of employees) and industry (e.g., Fullerton, Kennedy & Widener, 2014). Second, personal demographics, namely country of current job location, business, industry, company experience in years, hierarchical level, and department affiliation were gathered (e.g., Wagner, Grosse-Ruyken & Erhun, 2012; Fullerton, Kennedy & Widener, 2014). Third, possible influencing factors pertained to employee selection were included: the depth of the collaboration

between HRM and SCM (as the extent of it might influence selection decisions), their company's overall SCM priorities (as "responsive versus efficient" strategies might have implications for competency requirements), the respondent's functional background (i.e., which function they consider their core backgrounds, such as SCM, logistics, procurement, production, marketing/sales, etc.), and additional qualifications that could be considered important when evaluating potential job candidates ranked by distributing 100 points across the following items: Worked for direct competitor, worked for supplier/customer, international work experience, third language (additional to native and English proficiency), outstanding university grades, social commitment (e.g., student initiative, charitable institution, sports club, etc.), and other. Lastly, we asked whether respondents factored possible over-qualification into their assessments of candidates, as this might result in disregarding candidates who scored exceptionally in many attributes.

4.4.4 Sampling and Data Collection

Potential participants were contacted using the databases of the Kühne Logistics University and Copenhagen Business School that include contact details of 2,259 SCM- and SCM-related managers. They were contacted by email between April and June 2016 and invited to participate. Fourteen days after first contact, a friendly reminder was circulated to increase the number of responses. After eight weeks in the field, the experiment was completed. In total 265 completed responses were gathered, reflecting a response rate of 11.7%. However, 22 participants indicated no prior involvement in any employee selection decisions. As the studies aims to gather the opinions of knowledgeable respondents with previous hiring expertise only, these responses were removed for the subsequent analysis. The final sample was 243 responses, with an effective response rate of 10.8%; these figures are comparable to other studies in the field of SCM research

(e.g., Wagner, Grosse-Ruyken & Erhun, 2012; Devaraj, Krajewski & Wei, 2007). Table 4-2 presents the demographic statistics of our sample.

TABLE 4-2: DESCRIPTIVE SAMPLE STATISTICS

Industry	n	%		n	%		n	%
Automotive & Parts	38	15.6%	Employees			Business experience (in years)		
Chemicals	31	12.8%	<=50	1	0.4%	less than 5	15	6.2%
Construction & Materials	13	5.3%	51-500	17	7.0%	5-10	39	16.0%
Food & Beverages	18	7.4%	501-1,000	13	5.3%	11-20	107	44.0%
Healthcare	35	14.4%	1,001-10,000	47	19.3%	21-30	68	28.0%
Industrial Goods & Services	43	17.7%	10,001-50,000	64	26.3%	more than 30	14	5.8%
Oil & Gas	5	2.1%	More than 50,000	101	41.6%			
Personal & Household Goods	13	5.3%	Hierarchical level			Hiring involvement		
Retail	10	4.1%	Top management level	18	7.4%	Regularly	140	57.6%
Technology	20	8.2%	Middle management level	118	48.6%	Sometimes	103	42.4%
Telecommunication	9	3.7%	Lower management level	84	34.6%			
Utilities	3	1.2%	No management position	21	8.6%			
Others	5	2.1%	Other	2	0.8%			
Total	243	100%	Department			Country of employment		
			SCM	131	53.9%	Austria	10	4.1%
			Logistics	29	11.9%	Denmark	10	4.1%
			Procurement/Sourcing	24	9.9%	Germany	157	64.6%
			Production/Operations	10	4.1%	Switzerland	31	12.8%
			General Management	23	9.5%	Other	35	14.4%
			Other	26	10.7%			

The sample represents a wide variety of industries according to the Industry Classification Benchmark (ICB; FTSE Group, n.d.). Automotive & Parts, Health Care, and Industrial Goods & Service are the three most common industries in the sample; together they account for 47.7% of respondents. The majority of participants work for large or very large companies (67.9% of companies in the sample have more than 10,000 employees). Moreover, the typical respondent works in Germany (64.6%) as a middle manager (48.6%) in the SCM function (53.9%), is regularly involved in hiring decisions (57.6%), and possesses extensive business experience (>10-20 years, 44.0%), indicating that the sample consists of knowledgeable participants with the

ability to provide profound answers for the experiment. To account for potential non-response bias, the means of the part-worth utilities, question items, and descriptive variables of the first 30 respondents and last 30 respondents were compared using the Mann-Whitney U test (Lambert & Harrington, 1990; Wagner & Kemmerling, 2010). The last 30 respondents were treated as a proxy for non-responding managers (Armstrong & Overton, 1977). No statistically significant differences at the $p < 0.05$ level could be found, suggesting that non-response bias is not a threat for this study.

4.5 Analysis and Results

Hierarchical Bayes (HB) estimation was used to analyze the preferences of participants regarding candidate selection. HB is the premier choice for estimating part-worth utilities on an individual level, due to its estimation accuracy and efficiency (Lenk et al., 1996; Rao, 2014). The ACBC method allows for a two-stage analysis. First, the average preferences for the entire sample were estimated and interpreted. Second, heterogeneity in preferences was explored in the segmentation analysis by discriminating different types of managers making employee selections.

4.5.1 Aggregated Results

The competency preferences of the aggregated sample (243 responses) were analyzed as a first step. The analysis software integrated in Lighthouse Studio 9 was used to estimate individual part-worth utilities across all 18 attribute levels, as shown in Table 4-3. The average utilities in the second column are zero-centered, meaning that the sum of all part-worth utilities associated with an attribute equals 0. The table shows attributes in order of importance. The relative importance of each attribute was calculated following a two-step process. First, the value of each attribute was derived by subtracting the utility associated with the lowest level from the utility associated with the highest level of an attribute. Second, the values were normalized so as to sum to 100%.

This procedure allows for the comparison of utilities within and across attributes on a common scale (Verma, Thompson & Louviere, 1999).

Results indicate that *SCM knowledge* and *analytical & problem-solving ability* are the two most important competencies for a SCP&As, as indicated by their relative importance values in the right column of Table 4-3. The separate average utilities allow for deeper interpretation of the relative importance of each attribute.

TABLE 4-3: AVERAGE UTILITIES AND RELATIVE ATTRIBUTE IMPORTANCE

Attributes & Levels n = 243	Average Utilities	Standard Deviation	Lower 95% CI	Upper 95% CI	Relative importance
SCM knowledge					26.0%
Extensive	72.3	36.4	67.8	76.9	
Some	9.7	20.4	7.2	12.3	
None	-82.1	44.6	-87.7	-76.5	
Analytical & problem-solving ability					23.8%
Very good	62.8	22.2	60.0	65.6	
Good	16.4	17.3	14.3	18.6	
Basic	-79.2	34.8	-83.6	-74.8	
Interpersonal skills					19.1%
Very good	46.5	23.6	43.5	49.4	
Good	19.4	19.9	16.9	21.9	
Basic	-65.8	37.9	-70.6	-61.1	
Computer/IT skills					11.2%
Very good	28.5	17.7	26.3	30.7	
Good	7.3	10.7	5.9	8.6	
Basic	-35.8	23.7	-38.7	-32.8	
Industry experience					10.6%
Extensive	31.0	19.3	28.6	33.4	
Some	-0.6	11.8	-2.0	0.9	
None	-30.4	19.8	-32.9	-28.0	
General management skills					9.3%
Very good	24.8	17.1	22.7	27.0	
Good	1.2	11.8	-0.2	2.7	
Basic	-26.0	20.3	-28.6	-23.5	

CI = confidence interval

SCM knowledge is the most important attribute for successful SCP&As, according to the average utility score (26.0%) of all respondents. Hence, respondents, who make real-life hiring decisions, place the greatest emphasis on finding job candidates with a deep understanding of the SCM

function. More precisely, “extensive” SCM knowledge (72.3) provides approximately eight times the utility as “some” SCM knowledge (9.7). No SCM knowledge appears to virtually disqualify a candidate entirely (-82.1). This finding is particularly noteworthy, as functional knowledge elements scored relatively low in previous survey-based research papers. Among the 23 top-ranked skills (see Table 4-1), the only functional knowledge item was “transport & logistics” (ranked 13). Top-ranked items were heavily weighted toward interpersonal and general management skills.

However, in contrast to the skill items listed in Table 4-1, the finding is in line with online JAs: Function-specific knowledge/experience was the second-most advertised job requirement (Figure 2). Additionally, previous studies did not focus on SCP&As particularly.

Analytical & problem-solving abilities yields virtually the same importance (23.8%) as SCM knowledge. This finding is in accordance with previous studies. Naturally, SCM professionals are widely concerned with data analysis, conceptualization, information gathering, and problem identification. In particular, SCP&As need the capability to analyze, digest, and interpret large amounts of information. “Basic” analytical & problem-solving abilities are perceived as insufficient for the job (-79.2).

Interpersonal skills represent the third-most important competency with 19.1%. Although SCP&A’s job responsibilities are analytical and data-driven, they are employed in a cross-disciplinary function and thus must possess solid interpersonal skills (e.g., the ability to listen to colleagues from other functions, understand their language, and communicate avidly with all stakeholders to achieve common goals that provide maximum value to the firm and supply chain). Due to conflicting key performance indicators (e.g., inventory reduction versus high service

levels), they need to manage and align different people from warehousing, sales, and procurement to make decisions that maximize the benefit of the supply chain.

Computer/IT skills is ranked fourth, yielding a relative importance of 11.2%. This ranking contradicts the online JAs for SCP&As, which mention computer/IT skills as the second most frequent requirement. As HRM is usually in charge of composing and posting JAs for vacant positions, the discrepancies between respondent preferences and JA content are noteworthy as they could indicate a disconnect between departments. While the JAs promote strong computer proficiency as a key skill requirement, hiring managers making SCP&A selections only consider it “somewhat” important for the job.

Industry experience is defined as previous work experience or comparable relationships to the same industry (e.g., previous employment in the same company or at a direct competitor). The relative importance score is 10.6%. Most interestingly, “extensive” industry experience is highly valued by experiment participants (31.0) while the value of “some experience” is substantially lower (-0.6), especially in comparison to the second attribute levels of the four attributes discussed above. This indicates that industry experience is only considered valuable for SCP&A positions if it is extensive, namely the candidate is a true industry expert. Only possessing some industry experience adds little value.

General management skills are ranked as the least important attribute, at 9.3%. Apparently, management activities such as project management, supplier/customer relationship management, and risk management are not perceived to be as important as the other competencies. However, as the ACBC study design forces participants to make repeated trade-off decisions, some attributes levels must be de-prioritized to a certain extent. This is also reflected in the low utility score of “basic general management skills” (-26.0), translating into the expectation that candidates must

have better general management skills than that to match the job positions' demands. Still, the low relative importance of this attribute in general suggests that participants probably consider team leaders or department heads in charge of management activities rather than planners and analysts.

The last analytical step performed on the aggregated data was the estimation of a model that included all possible two-way interactions, using the 2-log likelihood test that Orme (2016) suggested could be a sensitive approach for modeling interaction effects between attributes in ACBC analysis. Assessing interaction effects in CA may be useful because two-way interactions have the potential to increase the predictive validity of the conjoint model (Green & Srinivasan, 1990). Although four interactions appeared to be significant at the $p < 0.05$ level (*interpersonal skills x analytical & problem-solving ability*, *analytical & problem-solving ability x SCM knowledge*, *SCM knowledge x industry experience*, and *interpersonal skills x industry experience*), the percentage gains over the additive main effects model for these four interaction terms were only 0.25%, 0.11%, 0.07%, and 0.06%, respectively. Orme (2016), however, recommends including interaction effects only if they increase the percentage gains for the main effects model by at least 1%. Otherwise, they do not add predictive validity and therefore do not improve the model; indeed, including too many two-way interactions can lead to undesirable overfitting of the initial model. Consequently, no interaction effects were added to the model shown in Table 4-3 and described above.

4.5.2 Segmentation Analysis

To account for the heterogeneous preferences of participants, CCEA was used to segment two types of managers. CCEA leverages a combination of multiple clustering approaches to produce a solution that uncovers the most apparent patterns in the data. As a result, the final segments reflect the consensus from a variety of different cluster solutions, hence, an “ensemble of

solutions” (Orme & Johnson, 2008). This methodology has been shown to be superior to conventional approaches that rely on a single clustering algorithm, as it produces the most reliable and robust patterns based on individual utility functions (Orme & Johnson, 2008; Strehl & Ghosh, 2002). More specifically, our ensemble solution was established using 70 separate cluster solutions, where 14 different cluster solutions (2-10;12;16;20;25;30) were tested with 5 different clustering methods each (k-means distance-based start, k-means density-based start, k-means hierarchical-based start, hierarchical average linkage, hierarchical complete linkage) (Sawtooth Software, 2013).

In this case, the two-cluster solution was reproduced in 93.8% of all cases over an ensemble of clustering solutions, indicating the solution was robust and had very high validity. The three-cluster, four-cluster, and five-cluster solutions achieved slightly lower reproducibility rates (81.6%, 86.4%, and 85.5%, respectively). In those solutions, both clusters that emerged from the two-cluster solution remained the largest clusters, with only a few cases splitting off to form separate clusters. Moreover, the differences in attribute utilities between the two clusters are most apparent and leave more room for interpreting those preference differences. For the given reasons, the two-cluster solution was chosen for an in-depth analysis and is shown in Table 4-4. The non-parametric Mann-Whitney U test was used to identify statistically significant difference across both segments as the part-worth utility values were not normally distributed.

Cluster 1 is the smaller of the two, comprising 38% of respondents. Respondents in this cluster place the greatest emphasize on deep SCM knowledge when selecting potential hires. The relative importance of SCM knowledge (39.1%) is twice as important as the second-ranked attribute, analytical & problem-solving ability (19.1%), which is still considerably more important than the following attributes. Interpersonal skills and industry experience follow as the third-tier attributes at 11.6% and 11.2%, respectively. Computer/IT skills (10.9%) follow, while general management

skills appear least important (8.0%), as in aggregated results. However, in general this type of senior manager can be described as very demanding, appreciating candidates with the highest level in each attribute. “Extensive” SCM knowledge (107.7) adds six times more value to this segment compared to the second highest level, “some” SCM knowledge (17.9), indicating that these hiring managers truly expect deep SCM knowledge from potential hires—possessing only limited (some) SCM knowledge is perceived as almost worthless. Moreover, extensive SCM knowledge is valued twice as much as the second most-valued attribute level, namely “very good” analytical & problem-solving abilities. As deep SCM knowledge is closely related to analyzing processes and solving glitches in the supply chain, the synthesis of those two competencies appears logical. In addition, possessing “extensive” industry experience as well as “very good” interpersonal, general management, and computer/IT skills is of high importance for these demanding participants. Based on their indicated preferences, this cluster is labeled “Expert Chasers.”

Cluster 2 prefers candidates that possess a more balanced competency profile, i.e., candidates that score “good” or “very good” in almost every attribute. In particular, the six attributes can be further grouped into three subgroups through consideration of their importance percentages. First and foremost, Cluster 2’s preferred candidate must combine strong analytical & problem-solving abilities (26.6%) with interpersonal skills (23.7%). Second, they emphasize SCM knowledge (18.0%) and computer/IT skills (11.4%). The third category consists of industry experience (10.3%) and general management skills (10.1%). A noteworthy similarity is that both clusters rank general management skills last and with similar relative importance. “Very good” analytical & problem-solving abilities (69.4), “very good” interpersonal skills (56.0), and “extensive” SCM knowledge (50.8) provide the greatest utility to this cluster’s members. Interestingly, “good” interpersonal skills (28.5) are valued as high as “extensive” industry experience (30.3).

Additionally, “good” analytical & problem-solving abilities are ranked higher than “very good” general management skills. According to their preferences, this cluster is called “Competency Balancers.”

TABLE 4-4: SEGMENTATION RESULTS

Segments	Expert Chasers	Competency Balancers	Mann-Whitney-U test
N	92	151	
%	38%	62%	
SCM knowledge	39.1%	18.0%	***
Extensive	107.7	50.8	***
Some	17.9	4.7	***
None	-125.7	-55.5	***
Analytical & problem-solving ability	19.1%	26.6%	***
Very good	51.9	69.4	***
Good	10.2	20.2	***
Basic	-62.1	-89.7	***
Interpersonal skills	11.6%	23.7%	***
Very good	30.7	56.0	***
Good	4.4	28.5	***
Basic	-35.2	-84.5	***
Computer/IT skills	10.9%	11.4%	
Very good	27.4	29.2	
Good	7.4	7.2	
Basic	-34.8	-36.4	
Industry experience	11.2%	10.3%	
Extensive	32.0	30.3	
Some	-0.4	-0.7	
None	-31.7	-29.7	
General management skills	8.0%	10.1%	***
Very good	21.1	27.1	***
Good	1.4	1.1	
Basic	-22.5	-28.2	**
Covariates¹⁾			
Possible over-qualification of candidate			*
Functional background of respondent			*
Social commitment of candidate			*
Nagelkerke's R ²			0.112

*** p<0.01, ** p<0.05, * p<0.1

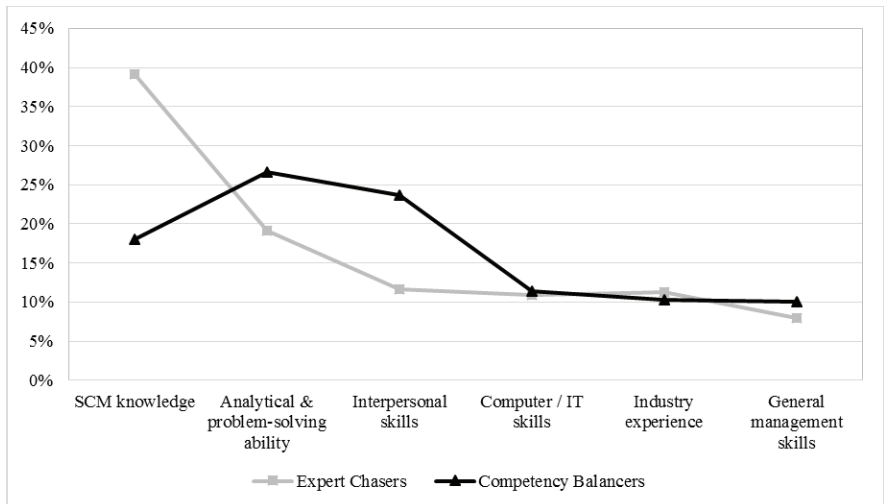
Relative importance (%) of attributes in **bold**

¹⁾ Predictors of group affiliation tested with binomial logistic regression: model $\chi^2 = 20.87$, $p = 0.076^*$

The following covariates were also included in the demographic section as control variables, but none of them differed statistically significantly across segments: SCM strategy (efficient vs responsive), business, industry, and company experience of respondents (years), reputation of the SCM planning function in the firm, extent of HRM-SCM collaboration, industry, country, and firm size (employees).

Figure 4-5 compares the relative attribute importance of both segments by visually highlighting the variation across segments. SCM knowledge clearly dominates the Expert Chasers' profile. In contrast, the Competency Balancers place more emphasis on analytical & problem-solving abilities and interpersonal skills attributes, hence balancing out their preferences. Correspondingly, the difference between the most and least important attribute for the Expert Chasers is 31.1% (SCM knowledge vs. general management skills) compared to only 16.5% (analytical & problem-solving ability vs. general management skills) for the Competency Balancers. However, the illustration also visualizes the commonalities across segments. Both groups agree that computer/IT skills, industry experience, and general management skills are of lower relative importance for SCP&As.

FIGURE 4-5: RELATIVE IMPORTANCE COMPARISON ACROSS SEGMENTS



Only three covariates differ significantly across the two types of senior managers. The limited ability to explain the different preference types with observable variables suggests that they are driven by hidden variables. Possible explanations are discussed in the following section

4.6 Discussion and Contextualization

Although numerous papers have studied the competencies of personnel in SCM, logistics, and procurement, no paper has specifically studied the competencies of SCP&As specifically nor has an ACBC experiment been employed for that purpose. This section aims to discuss and contextualize this study's commonalities with and deviations from previous ones. Despite the focus of prior studies on different employee groups, a considerable overlap in competency requirements can still be expected, as many jobs in SCM are charged with similar objectives (e.g., achieving certain service levels or reducing total supply chain costs).

4.6.1 Deviations from Previous Studies

The presented study provides important deviations from previous academic work. First, SCM knowledge unexpectedly ranked as competency with the highest relative importance (26.0%). Previous work has repeatedly suggested "soft skills" have greater importance (Harvey & Richey, 2001; Giunipero & Percy, 2000; Murphy & Poist, 2007; Wu et al., 2013). This notion is also reflected in Table 4-1, which only features one item from the "functional knowledge" category. Also as shown in Chapter 3, the backgrounds of supply chain executives pointed toward a diverse management career rather than a strong functional background. Lateral hires with previous staff responsibility were represented more frequently than "homegrown" SCM experts, suggesting higher importance of general management and interpersonal skills for that position. However, the deviations in job requirements might be explained by the varied perspectives of employees at different levels in an organization. Executives are less involved in the daily, content-based workflows that require deep functional knowledge. Rather, they are more engaged in orchestrating teams, delegating tasks, making decisions, and developing future strategies.

Only one study on skill requirements found results that were similar to this study's. Kovács, Tatham and Larson (2012) find in their survey- and interview-based study on humanitarian

logisticians that functional skill items, such as inventory management, warehousing, and transport are more highly ranked than soft skills. Although humanitarian logisticians are a special subgroup of SCM employees that deal with very different daily challenges than traditional businesses, the comparable prioritization is noteworthy.

The use of segmentation to differentiate hiring managers with distinct preferences within a homogenous sample distinguish this study from previous work and highlight one of ACBC analysis' advantages over conventional survey methods.

4.6.2 Inexplicability of Different Preference Types

An objective of this paper was to identify SCM decision makers with different preferences toward a job candidate's competency profile. This objective was achieved. Even so, a variety of individual and firm-specific covariates describing supply chain strategy, extent of HRM-SCM collaboration, and the reputation of the SCM planning function could not explain the origin and reasons for those differences. Three covariates showed at least weak differences across segments, based on binomial logistics regression analysis. First, Competency Balancers are not concerned a candidate may be overqualified for a position, whereas Expert Chasers expressed concerns when faced with a candidate who featured the highest possible levels in each of the six attributes. In particular, Expert Chasers commented they feared that an overqualified candidate would grow bored by the position's usual duties and rapidly seek other job opportunities. Second, in line with the Competency Balancers' overall preference for multifaceted talents, they valued evidence of social commitment (such as membership in a student initiatives or sports club) as a positive signal, while Expert Chasers showed no particular preference for this. Third, the functional background of Competency Balancers and Expert Chasers differs. Respondents with marketing/sales and logistics backgrounds were more likely to belong to the Expert Chasers group, while respondents with other backgrounds (SCM, procurement, production, or others) are represented roughly

equally in both groups. However, given the relatively low Nagelkerke's $R^2 = 0.112$ and weak significance values, additional determinants for preference types likely exist that were either not covered or difficult to expose. The absence of quantitative explicability might be rooted in the fact that selecting a future member of a team is strongly driven by subjective criteria (Wade & Kinicki, 1997), as hiring managers usually rely on their personal judgement of job-relevant requirements and applicants' competencies (Gatewood, Feild & Barrick, 2016). In fact, numerous respondents noted in an open comments field that they rely on their "gut feeling." Other comments pointed in a similar direction by identifying "sympathy," "chemistry," "personality," "needs to fit the team," "attitude," and "appearance" as key selection criteria. This raises the question whether firms have standardized guidelines and concepts that outline critical requirements for SCP&As in place. Presumably, many firms leave employee selection entirely up to the hiring manager. This approach is surprising as various studies suggest that choosing the right people that meet the requirements of the job is critical to the success of the firm (Caldwell & O'Reilly III, 1990).

4.7 Conclusion

4.7.1 Contribution to the Literature

The study extends the literature in several ways. First – to the best of my knowledge – the competency requirements and selection criteria for SCP&As have not been the objective of an academic paper to date, despite their critical contribution to SCM across industries and regions. Second, when preparing for the main analyses, a meta-analysis of survey-based papers on competencies required for SCM, logistics, and procurement was conducted and the aggregated means at the item level was presented. Moreover, the competency requirements found in 200 current online JAs for SCP&As were analyzed. Third, previous insights from survey- and case study-based papers on related SCM personnel groups were extended by investigating and ranking

competencies in relation to each other. This was achieved by introducing ACBC analysis to the SCM research literature. Finally, the study responded to recent calls for more interdisciplinary research in the intersection of HRM and SCM (Fisher et al., 2010) to enhance the understanding of scarce personnel in SCM.

4.7.2 Managerial Implications

The study's results have multiple managerial implications. Although most firms heavily invest in strategic recruitment activities and advanced selection methods such as assessment centers and case studies, the findings suggest that SCP&A selection is often driven by an interviewer's subjective criteria. Multiple quantitative covariates were not able to measure or explain the determinants of different preferences toward a candidate's competencies. In response, firms' HRM and SCM experts should invest joint efforts to define objective requirements to ensure a candidate's profile matches the needs, strategic goals, and organizational culture. For example, if the planning team currently consists of staff with broad, multifaceted managerial backgrounds, a true expert with extensive SCM knowledge and industry experience might better supplement the team than another well-rounded talent. Companies should ultimately strive to form organization-wide recruitment and selection policies with precisely defined requirements for different job positions that reduce the influence of subjective criteria. Moreover, the differences between the competency requirements most frequently highlighted in online JAs (computer/IT skills, see Figure 2) and the relative importance of these attributes as indicated by the study results (only 11.2%) indicates a disconnect between SCM and HRM, supporting the concerns raised by our research outlined above (Cottrill & Rice Jr., 2012; Fisher et al., 2010). In other words, SCP&A JAs do not adequately reflect the candidate profiles desired by hiring managers. Unqualified candidates might apply while qualified ones might not. In response, HRM and SCM should

facilitate closer collaboration to design appropriate JAs that increase the number of applications that actually meet the demands of the position and the hiring manager.

4.7.3 Limitations and Future Research Opportunities

This study had certain limitations. First, only six competency attributes could be included in the study, due to the experimental design constraints of conjoint studies. In general, KSA are multidimensional and expressed by numerous facets, which makes aggregation to a few categories difficult. For the same reasons, competencies were the only job selection criteria included in the experimental design. However, given that most of the existing literature has used surveys, the previously-described upsides of the ACBC analysis approach outweigh the downsides, as this study extends existing knowledge on SCM competencies. Second, although this study focuses on a specific SCM employee group, planning and analysts jobs might differ by company, depending on various circumstances and business environments. Consequently, the competency requirements are not generalizable per se to any planner and analyst position. However, the attempt to incorporate six broad competency attributes should reduce this limitation to very special environments. Lastly, only European managers, most notably from Germany, participated in the experiment. Inter-cultural idiosyncrasies regarding personal traits, company culture, and employee behavior determinants of selection decisions might mean that North American and Asian managers would respond differently.

This paper opens up promising avenues for future research. This study focuses on the selection criteria for hypothetical candidates without considering the team composition of the recruiting company. Accordingly, employee selection criteria could be studied on a firm level under consideration of the competency profiles of entire teams. From a methodological perspective, the research design could be replicated with other employee groups in SCM (e.g., managers and executives). The opportunities for application of ACBC analysis go far beyond that, though. For

instance, similar to Anderson et al. (2011), fellow scholars could adopt the method to study determinants of supplier, service provider, and strategic partner selection in supply chains.

Appendix 4-A: Sample Screenshots of ACBC Experiment

Welcome!

Please read the following scenario carefully
(the "Continue" button will appear after 20 seconds):

In the following, we will turn your attention to a **hiring situation**.

We would like you to imagine that you are trying to fill a vacant job position for a **Supply Chain Planner or Supply Chain Analyst** (who will report directly to you).

Suppose that several candidates have passed the first assessment based on their written application and were invited to a job interview by HR. They are theoretically employable, i.e., they are available on the job market, and demand a reasonable salary.

Based on the interview during which you were part of the assessment committee, you were able to observe **six different competency attributes**.

In the following, we will show you sets of different candidates. First, we will ask whether a candidate is a "possibility" for recruitment or not based on his competencies. Afterwards, we will ask you to select the candidate you prefer out of a set of three candidates multiple times.

It is important that you answer as if you were actually making this hiring decision.

During the course of the experiment, we will ask you to evaluate the potential candidates on the attributes listed below.

Here are some examples for the different competencies:

- Analytical and problem-solving abilities**
- Data analysis
 - Conceptualization
 - Information gathering
 - Number affinity
 - Problem identification
 - ...

- Computer / IT skills**
- Excel
 - PowerPoint
 - SAP
 - ERP
 - Database tools
 - ...

- General management skills**
- Project management
 - SRM / CRM
 - Risk management
 - Finance & accounting
 - Change management
 - ...

- Industry experience**
- Previous employment at the same company or BU
 - Previous employment at a direct competitor
 - Comparable previous relationship with industry
 - ...

- Interpersonal skills**
- Listening
 - Oral communication
 - Written communication
 - People management
 - Negotiation
 - ...

- SCM knowledge**
- Inventory management
 - Logistics network design
 - Transport management
 - Procurement
 - Sales & operations planning
 - ...



Please read the description below carefully to ensure a mutual understanding of the attribute levels throughout the experiment.

Attributes	Levels	Examples
Analytical and problem-solving abilities	Very good Good Basic	Very good in the respective category, e.g., <ul style="list-style-type: none"> ▪ Interpersonal skills: very good listener, very strong team player and communicator ▪ Computer / IT skills: outstanding skills in company- and job-relevant software packages ▪ ... Good in the respective category, e.g., <ul style="list-style-type: none"> ▪ General management skills: good project manager, good sense of financial metrics ▪ Analytical and problem-solving ability: quick analyzer of large amount of data ▪ ... Basic in the respective category, e.g., <ul style="list-style-type: none"> ▪ General management skills: able to manage multiple tasks at the same time ▪ Computer / IT skills: has worked with relevant software packages before ▪ ...
Computer / IT skills		
General management skills		
Interpersonal skills		
Industry experience	Extensive Some None	Extensive knowledge/experience, e.g., <ul style="list-style-type: none"> ▪ Industry experience: several years of working experience in the same industry ▪ ... Some knowledge/experience, e.g., <ul style="list-style-type: none"> ▪ SCM knowledge: previous intersections with SCM, or SCM lectures in college ▪ ... None – no knowledge/experience, e.g., <ul style="list-style-type: none"> ▪ Industry experience: No prior work in the same or a related industry ▪ ...
SCM knowledge		



Here are a few candidates you might like. **For each one**, please indicate whether it is a possibility or not.
(1 of 6)

Interpersonal skills	Basic	Basic	Good	Very good
Analytical and problem-solving ability	Basic	Good	Very good	Basic
Computer / IT skills	Good	Very good	Basic	Basic
SCM knowledge	Extensive	Extensive	Some	None
General management skills	Good	Good	Good	Very good
Industry experience	None	None	Some	Extensive
	<input type="radio"/> A possibility <input type="radio"/> Won't work for me	<input type="radio"/> A possibility <input type="radio"/> Won't work for me	<input type="radio"/> A possibility <input type="radio"/> Won't work for me	<input type="radio"/> A possibility <input type="radio"/> Won't work for me

Helpful links: [Attribute definition](#) | [Level definition](#)



We've noticed that you've avoided candidates with certain characteristics shown below. Would any of these features be **totally unacceptable**? If so, mark the **one feature** that is **most unacceptable**, so we can just focus on candidates that meet your needs.

- General management skills - Basic
- SCM knowledge - None
- Analytical and problem-solving ability - Basic
- Interpersonal skills - Basic
- Industry experience - None
- Computer / IT skills - Basic
- None of these is totally unacceptable.

Helpful links: [Attribute definition](#) | [Level definition](#)



We don't want to jump to conclusions, but we've noticed that you've selected candidates with certain characteristics shown below. If any of these is an **absolute requirement**, it would be helpful to know. If so, please check the **one most important** feature, so we can just focus on candidates that meet your needs.

- Industry experience - At least: Some
- Computer / IT skills - At least: Good
- Analytical and problem-solving ability - At least: Good
- General management skills - At least: Good
- None of these is an absolute requirement.

Helpful links: [Attribute definition](#) | [Level definition](#)



Among these three, who is the **best** option for you?

(2 of 7)

Interpersonal skills	Very good	Good	Very good
Analytical and problem-solving ability	Very good	Good	Very good
Computer / IT skills	Good	Very good	Good
SCM knowledge	Extensive	Extensive	Some
General management skills	Good	Good	Very good
Industry experience	Some	Some	Extensive
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Helpful links: [Attribute definition](#) | [Level definition](#)



The experiment was limited to six competencies only - of course there are also other qualification: What additional qualification would you consider as important, too?

Please distribute a total of 100 points between the items. You can also give 0 points to items or leave fields blank, respectively.

Worked for direct competitor

Worked for supplier/customer

Outstanding university grades

Social commitment (e.g., student initiative, charitable institution, sports club, etc.)

Third language (additional to native + English proficiency)

Working experience abroad

Other:

Total



How many years in total have you worked in the industry of your current employer?

If your company is active in multiple industries count the one of your current BU

- less than 2 years
- 2 to 5 years
- 6 to 10 years
- 11 to 20 years
- More than 20 years

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, product manager)
- No management level (e.g., specialist, expert)
- Other



5 Discussion and Conclusion

This chapter concludes the dissertation by summarizing the insights the studies have provided, and discussing their contribution to the literature, their managerial implications as well as limitations and future research opportunities.

The overarching purpose of this interdisciplinary dissertation has been to shed more light on the people managing supply chains. SCM researchers (Hohenstein, Feisel & Hartmann, 2014), SCM practitioners (John, 2015) and HRM scholars (Fisher et al., 2010) have mutually called for more research on HRM issues in supply chains and highlighted the lack of knowledge on the “people dimension” (Wieland, Handfield & Durach, 2016). The three empirical papers constitute an important step in addressing this research gap by generating more knowledge on the supply, demand, and contribution of supply chain personnel and raising awareness for future research on the subject matter.

5.1 Summary of Empirical Findings

In the first paper, in Chapter 2, we investigate the effects of individual SCM competencies and organizational SCM knowledge on multiple SCM and financial performance indicators considering two antecedent factors, organizational learning and corporate training. Using SEM, we show that individual SCM competencies and organizational SCM knowledge contribute substantially and equally to a firm’s SCM performance, and indirectly to a firm’s financial performance. Moreover, we identify organizational learning as a strong enabler of both, individual SCM competencies and organizational SCM knowledge. As a consequence, it contributes indirectly to SCM performance as shown with a bootstrapping mediation analysis. Our findings are in line with those of previous studies that showed a positive relationship of competency and knowledge (Hult et al., 2006; Ellinger et al., 2011; Giunipero, Dawley & Anthony, 1999) and organizational learning (Hult, Ketchen Jr. & Nichols Jr., 2003; Ellinger, Ellinger & Keller, 2002)

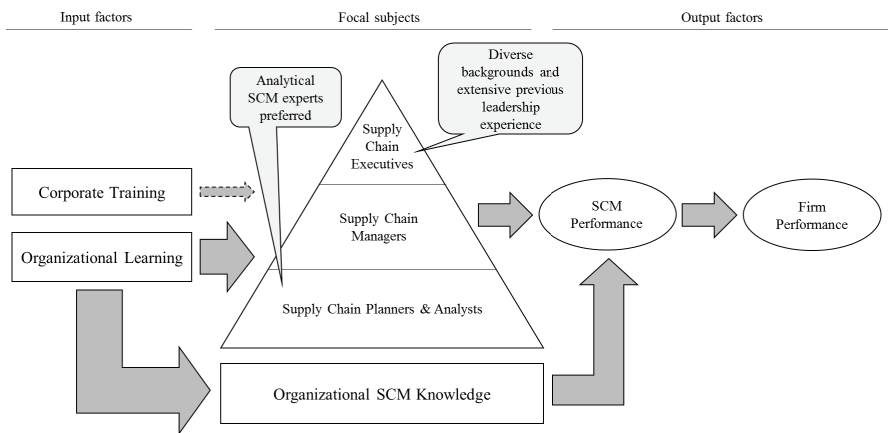
to performance. However, the seriously limited positive effect of corporate training on developing individuals is contrary to previous findings (Gowen & Tallon, 2003; Aguinis & Kraiger, 2009). For that case we conclude, in line with another recent study, that well-designed training initiatives should, indeed, enhance individual competencies in the SCM context, but fail to do so for multiple reasons, such as insufficient training budgets, poor training needs assessment, and a poor mixture of training methods (Gibson et al., 2013).

In the second paper, in Chapter 3, we study career paths of SCEs. Based on OMA, we reveal six distinct career patterns that emerged from 307 unique resumes. Particularly, between the clusters, there is a great difference in previous professional experience, field of studies, types of degrees, and time needed to arrive in an SCE position among other variables. The great variation in career courses indicates that the cross-functional orientation of SCM truly resembles the knowledge and experience of SCM staff. The analysis of the aggregated sample uncovers a particularly surprising finding regarding the professional career paths: While 56% of all SCEs previously held an executive position elsewhere, only 28.7% had previously worked in SCM. We, therefore, conclude that previous staff responsibility experience appears to be valued higher by firms when selecting SCEs than extensive SCM experience. Furthermore, we show that exceptional careers regarding rapidness of advancements, were driven by a combination of factors, i.e., starting off with a graduate degree or Ph.D. and climbing the ladder through SCM or consulting functions.

In the final paper, Chapter 4, I study the determinants of selection of supply chain planners and analysts, the relative importance of six KSAs and types of supply chain executives with employee selection responsibility. Leveraging experimental data of an ACBC analysis that possesses several methodological advantages over conventional Likert-scaled surveys functional SCM knowledge and analytical & problem-solving ability are identified as the highest ranked KSAs, while managerial and computer/IT skills are rated substantially lower. This is in stark contrast to

practitioners’ indications in earlier survey-based papers (Murphy & Poist, 2006; Gammelgaard & Larson, 2001; Kovács, Tatham & Larson, 2012) in which they placed much less emphasis on deep functional knowledge and analytical skills; instead, they continually rated numerous elements belonging to “soft skills” categories, such as interpersonal and management skills, much higher. Based on the experimental results, “analytical SCM experts” are first choice for a supply chain planning position.

FIGURE 5-1: DRAWING THE BIG PICTURE OF THE GENERATED INSIGHTS



Note: Width of arrows reflect the proportional effect sizes observed in Chapter 2

Figure 5-1 aims to draw the big picture of this dissertation by integrating the main findings of the three studies. The hierarchical pyramid resembles the proportions of the SCM workforce in practice. Most tasks rest on the shoulders of many SCP&As whose competencies should consist of deep functional SCM knowledge and analytical & problem-solving abilities. SCEs manage the SCM workforce by using their extensive leadership experience and holistic overview of various business fields. Supply chain managers have not been a specific subject in this study. However, the three employee levels as a whole have been positively linked to SCM performance in

Chapter 2. They do so with similar magnitude of organizational SCM knowledge. Organizational learning and corporate training have been hypothesized as important antecedents that facilitate individual competencies and organizational knowledge. However, only organizational learning's positive effect was substantial in developing individual competencies and organizational knowledge.

5.2 Theoretical Contributions

The theoretical contributions of the three separate papers have been previously discussed in Sections 2.6.1, 3.6.1 and 4.7.1, respectively. Therefore, this section aims to extend the previous discussion and reflect how and to what extent this dissertation contributes to the literature.

5.2.1 Extending the T-shaped Competency Profile of Supply Chain Personnel

One of the most popular frameworks to explain the competency requirements of supply chain personnel was proposed by Mangan and Christopher (2005). In their paper, the authors conceptualize the necessity of broad cross-functional skills and understanding of other business areas (horizontal orientation) and deep functional SCM knowledge (vertical orientation) for “the supply chain manager of the future” in the form of a T-shaped skills profile. Due to the framework's compelling logic, it was adapted and modified in subsequent research. Kovács, Tatham and Larson (2012) modified the T-shaped profile to conceptualize the competency requirements of humanitarian logisticians. This was achieved by adding an extra humanitarian logistics-specific competency category to the generic framework. Subsequently, the framework served as a basis for empirically studying the hierarchical ranking of competency items.

Such specific extensions of generic frameworks contribute to the literature by offering applications for future research on finer levels. Accordingly, an extension of the generic T-shaped competency profile for SCP&As could offer a basis for further research on their competencies.

Moreover, it could provide an example that serves as a foundation for specific competency profiles of other SCM employee groups.

FIGURE 5-2: THE T-SHAPED COMPETENCY PROFILE OF CONTEMPORARY SCP&AS¹⁴

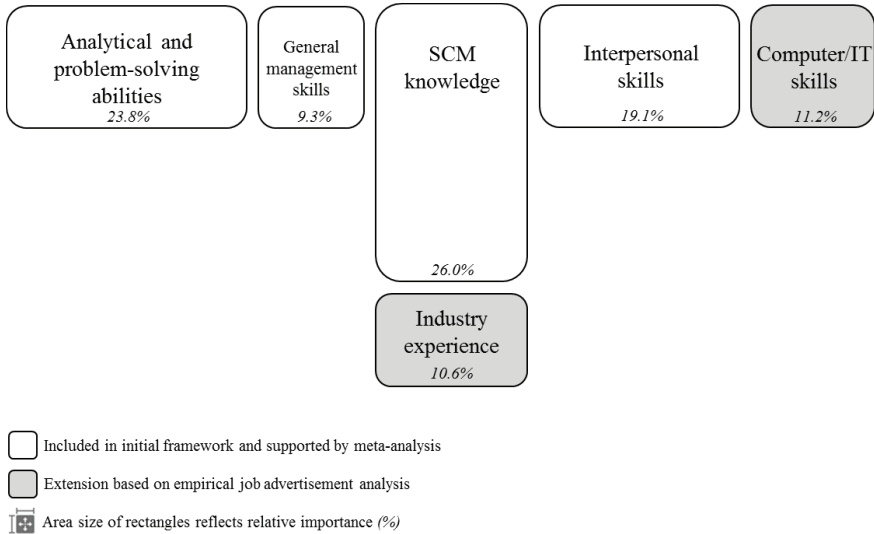


Figure 5-2 presents the extension of the T-shaped competency profiles for SCP&As. Hereby, the extensions are twofold and go beyond those of Kovács, Tatham and Larson (2012). First, two competency categories were added from the empirical analysis of recent online JA conducted in Chapter 4, i.e., computer/IT skills and industry experience. Computer/IT skills have been added on the horizontal axis, representing a broad competency applicable to many jobs including those outside the scope of SCM. This category was not present in the initial framework. A possible explanation for the need of inclusion might be the rapid development of IT systems and software solutions in SCM that require higher computer proficiency. Industry experience was added to the functional knowledge column (vertical) as industry experience in SCM-related activities is rather

¹⁴ Adapted from Mangan & Christopher (2005).

specific and, therefore, valuable for SCM positions in particular. The value of industry experience could be driven by the nature of the SCP&As' profession. Planning the supply and demand of various product groups and raw materials along the supply chain may require a solid understanding of industry-, country-, and product-specific regulations, which is only obtainable through previous learning on-the-job. As a second feature, the illustration was modified so that the area sizes of the rectangles visually reflect the relative importance revealed by the ACBC analysis. This visual modification integrates further information into the figure and could serve as a useful feature for future frameworks.

5.2.2 Reflections on the Theoretical Contribution

This dissertation aims to elevate the theoretical and practical knowledge of people involved in SCM. This subsection reflects how this theoretical contribution was accomplished.

When judging whether an OM or SCM theory qualifies as “good” or not, Wacker (1998) argues that it should meet, to some degree, each of eight proposed “virtues of good theory.” These virtues should become goals to reach for the researcher during the development of theories. It should be carefully noted that Wacker refers to theory more technically than philosophically. Therefore, theory should not be confused with “grand theories” such as the resource-based or principal-agent theory. Rather, he perceives theory as the product of academic research, for instance, to provide a clear explanation as to why certain phenomena occur. According to his definition (p. 363), a theory is composed of four components: i) definition of variables, ii) a domain where it applies, iii) a set of relationships of variables, and iv) specific predictions (factual claims). Hence, before any reflections on the goodness of the three papers can be made, they have to qualify as theory by first possessing these four components.

The first criterion is undoubtedly fulfilled as all papers apply quantitative methods that are used to analyze empirical data consisting of clearly defined variables (i). Also, all papers are centered in a specific domain (ii), i.e., they are concerned with linking HRM and SCM research. Furthermore, all papers describe, explain, or test relationships between variables (iii). Although only Paper 1 features a true theory-testing approach where hypothesized relationships between variables can be tested statistically, Papers 2 and 3 also fulfill the internal consistency criterion (as elaborated below and in Table 5-1), meaning they assume relationships between variables. Lastly, all papers make factual claims (iv): Paper 1 finds statistical relationships between modeled constructs; Paper 2 reveals six career patterns and drivers of career advancements; and Paper 3 discovers the utility functions of respondents and the relative importance of six competencies. In conclusion, as the three papers qualify as theory, the goodness of them can be subsequently assessed.

A brief explanation of Wacker's eight virtues of good theory follows. The first virtue is *uniqueness*, which means that the theory must be distinguishable from previous theories. The second virtue, *conservatism*, states that a new theory must be superior to the previous theory to replace it, i.e., it extends previous work. *Generalizability*, the third virtue, means that a theory ideally should be applicable to many environments, or conversely, the narrower the scope of a theory, the worse it becomes. The fourth virtue, *fecundity*, refers to a theory's fertility in generating new models and hypotheses to expand the area of research. The fifth virtue, *theory parsimony*, refers to the need for simplicity and comprehensibility. Fewer assumptions, fewer definitions and less complexity should be the goal to make a theory more virtuous. *Internal consistency*, the sixth virtue, means that a good theory logically or mathematically explains the relationship between variables. This also means the concepts in the theory must be compatible with each other. *Empirical riskiness* refers to the fact that the theory that explains or predicts a

less likely event is the better theory, because a theory that predicts a very likely event is not very valuable or useful. The last, and eighth virtue, is concerned with the level of *abstraction* of a theory. Higher abstraction is more virtuous, as such a theory is more independent of time and space. In other words, theories with high abstraction usually have a wider scope and are applicable to more phenomena and environments. Theories with low abstraction levels only hold for a few instances. However, in real life, theories often progress step-by-step from low to middle to high abstraction levels. Therefore, a theory with low abstraction level can be useful as it sets the foundation for better theories to emerge (Wacker, 1998).

The following section reflects on the goodness of the developed theories of the separate papers by discussing their match with the eight virtues. These reflections are summarized in Table 5-1.

Paper 1 proposes a *unique* model to understand the contribution of individual SCM competencies under consideration of related factors. Its integrated model encapsulates some form of *conservatism* by extending previous papers that considered constructs independently or in a different environment. The data sample consisting of knowledgeable survey respondents from different industries, countries and hierarchical levels aims to establish an appropriate degree of *generalizability* in the findings. The comprehensive analysis that discovers the magnitude of multiple statistical relationships could serve as *fertilizer* for subsequent studies, e.g., by exploring the effect of other HRM activities on competencies. Despite the model's fair amount of complexity, the *internal consistency* reflected by logical elaboration on the hypotheses, the illustration of the relationship between variables, and the statistical testing should ensure a good level of comprehensibility (*theory parsimony*). Although all hypotheses are at least partially statistical significant, the absolute effect sizes and their magnitudes in relationship to each other were unexpected a priori, suggesting *empirical riskiness*. Lastly, the broad scope on "SCM

personnel in general” as well as the inclusion of 41 variables representing six concepts in the model suggest a high level of *abstraction*, which is desirable for providing good theory.

Paper 2 fulfills the *uniqueness* virtue in several ways. First, it is the first paper to analyze career paths of SCEs. Second, it is the first to use biographic data gathered from an online social network for that purpose. Third, it is the first paper in SCM research to apply optimal matching analysis. Simultaneously, it supplements prior research that was concerned with career satisfaction and career opportunities, as well as recent papers on the role and impact of SCEs on firm performance (*conservatism*). The data, which consists of long sequences of variables that were classified into 14 commonly distinguished functions, should ensure a solid level of *generalizability*. By shifting the attention to the “supply side” of people in SCM it serves as *fertilizer* for this research perspective. In the past, most papers have focused on studying what companies demand from SCM personnel (demand side). The rather simple six- and four-pattern solutions reflect *parsimony* and comprehensibility of the work. Also, the utilization of an inverse transition frequency matrix and the nature of OMA, which treats sequences as a whole rather than disentangled variables, suggest *internal consistency* of the theory. Naturally, due to the paper’s exploratory approach without the option of making predictions, it is not especially *empirically risky*. However, exploratory studies are still useful to facilitate later theory-testing research (Meredith et al., 1989). Lastly, Paper 2 offers a decent level of *abstraction*. On the one hand, it incorporates a large number of variables and cases to draw a comprehensive picture. On the other hand, the scope is placed only on the SCE level, excluding data on other employee groups.

TABLE 5-1: REFLECTIONS ON THE GOODNESS OF DEVELOPED THEORIES¹⁵

	Paper 1	Paper 2	Paper 3	
Research topics	Performance contribution of individual SCM competencies and organizational knowledge	Backgrounds of SCEs	Competence requirements and selection criteria of SCP&As	
Developed theory	Develops integrated model to study the relationships of individual competencies, organizational knowledge, performance outcomes, corporate training, and organizational learning jointly	Proposes approach to reveal career patterns from the biographies of SCEs and exposes drivers of career advancements in SCM	Provides a relative importance ranking of six broad competence attributes and distinguishes two different types of managers making employee selections	
Eight virtues of good theory	Uniqueness	First to combine the underlying concepts into one integrated model	First to employ ACBC analysis on competence requirements and selection criteria in SCM context	
	Conservatism	Extends papers that have studied the concepts independently or in other contexts (e.g., Hult et al., 2006; Hult, Ketchen Jr. & Nichols Jr., 2003; Ellinger et al., 2012)	Supplements previous SCM career research (e.g., Cooper et al., 2012; Goffnett et al., 2012) and extends knowledge on the people in SCE roles (e.g., Hendricks, Hora & Singhal, 2014; Roh, Krause & Swink, 2016)	Extends research on competencies (e.g., Gammelgaard & Larson, 2001; Murphy & Poist, 2007) and hiring in SCM (e.g., Gibson & Cook, 2001; Myers et al., 2004)
	Generalizability	Applicable to SCM personnel across industries and countries	Insights generally applicable, but probably most accurate for European SCEs	Applicable to SCP&As in broad terms
	Fecundity	Suggests joint consideration of factors and their relationships	Shifts attention to the supply side, i.e., competencies & experience of SCM personnel	Suggests experimental investigation of competencies to reproduce employee selection decisions more realistically
	Theory parsimony	Complex relationship structure, yet still comprehensible	Descriptive research with cluster solutions and, thus, easily comprehensible	Reduction to six broad competence attributes and, thus, easily comprehensible
	Internal consistency	Yes, sound hypothesis development, illustration of relationships, and statistical measurement	Yes, OMA treats sequences and its elements (variables) as intrinsically tied together and dependent on each other	Yes, HB considers and estimates all possible relationships of variables
	Empirical riskiness	Yes, theoretical predictions are developed and tested empirically	No predictions given due to the exploratory character of the study	No hypotheses developed to be tested, but findings deviate from predictions based on previous papers and JAs
	Abstraction	High abstraction level: scope on SCM in general	Middle abstraction level: scope on SCE level only, but across companies, industries, and countries	Middle abstraction level: scope on SCP&As only, but across companies, industries, and countries

¹⁵ Framework adopted from Wacker (1998).

Paper 3, similar to Paper 2, distinguishes itself through its *unique* research methodology and the studied target group. Consequently, it extends previous research on competencies and hiring decisions through its innovative approach (*conservatism*). Moreover, the thorough development of six broad competency categories suggest a high degree of *generalizability*. Similar to Paper 2, the introduction of a new research methodology could serve as seed corn for further research employing ACBC analysis to capture complicated trade-off decisions in various SCM practices (*fecundity*). Also, the experimental design that resembles a real-life employee selection situation makes few assumptions, ensuring *theory parsimony* and *internal consistency*. Internal consistency is further facilitated through a hierarchical Bayes estimation that accounts for all possible relationships among variables. Similar to Paper 2, this study was of an exploratory nature, preventing theory testing. However, drawing from previous studies on SCM competencies, certain results were expected and deviations from it could be discussed, suggesting at least a certain degree of *empirical riskiness*. Lastly, the theory possess a middle level of *abstraction*. Although the experimental design reproduces a real-world selection scenario that could be realistic for numerous employee groups, it was specifically tailored to SCP&As.

In conclusion, the discussion above suggests that, overall, each of the three papers has met Wacker's (1998) eight virtues to some degree, indicating that this dissertation has contributed "good" theory on people in SCM.

5.3 Practical Implications

One of the purposes of this dissertation was to bridge HRM and SCM research and to support future management decisions in practice. Almost 600 CSCOs indicated that HRM issues are among the severest challenges SCM professionals currently face (John, 2015). Also, a significant share of the same CSCOs conclude that supply chain talent is non-satisfyingly understood within firms and that HRM plays only an administrative role instead of offering desirable strategic

support. Findings of this dissertation, indeed, point in a similar direction. Chapter 2 concludes that training programs have very limited positive effects on SCM competencies. The design of training programs is usually one of HRM's main responsibilities and the findings suggest that there is room for improvement. Voluminous HRM literature addresses how to design training programs properly (Noe et al., 2014; Stewart & Brown, 2011). Consequently, the problem appears to be rooted in execution rather than the lack of accessible know-how. For instance, according to Stewart and Brown (2011), the model of training design should comprise *needs assessment, design and delivery, and evaluation*. Hereby, the needs analysis consists of organizational analysis, task analysis, and person analysis. The goals of the three analyses steps is to identify the characteristics of the organizational environment that will influence the effectiveness of training, describe the work activities to determine the competencies required to complete the tasks, and identify the people who need training and their profiles to design it accordingly. Consequently, there is no "one size fits all" solution. This has also been indicated by the diverse educational and professional backgrounds of SCEs in Chapter 3. People with different backgrounds need very different training to convert their weaknesses into strengths.

As a subsequent step, appropriate training methods must be selected. Currently, many companies rely solely on simple on-the-job training (Gibson et al., 2013), which is insufficient to develop contemporary SCM professionals. Instead, comprehensive training programs should use a selective combination of various training methods that best meet the needs of the target group, such as blended learning approaches, experiential learning, and e-learning. Moreover, companies, especially small and medium sized enterprises, should consider external support of training experts, i.e., sending employees to certified trainings hosted by international SCM associations, such as CSCMP and APICS. Looking back on decades of training experience, continual updating of curricula, and close ties to academia and industry, first-class training content and methods are

accessible without the need for high investments for internal training capability building (McKinnon, Flöthmann & Hoberg, 2016).

Organizational learning was identified as a strong enabler of individual SCM competencies and organizational knowledge. It was associated with the acquisition, distribution and integration of information in Chapter 2, which suggests that its facilitation is beyond the scope of traditional HRM. However, that is not entirely true. As elaborated on in Section 2.5, organizational culture is the most important antecedent of superior organizational learning. In particular, participative decision-making, organizational openness, learning orientation, and transformational leadership are crucial in fostering a learning mindset and environment. Here, HRM can get involved by facilitating a culture of open and honest communication among superiors, subordinates and peers that accepts open debates and admission of mistakes. For example, an open communication culture could be initiated through HRM initiatives, such as team building events or joint activities after work. Especially in SCM, where teams consist of members with diverse cultural backgrounds that imply different forms of communication (Hofstede, 1980), rules for harmonious coexistence must be clearly defined. Superb staffing activities and decisions also ease the way for participative decision-making. If HRM is capable of selecting and hiring the best-qualified applicants, decision-making responsibility can be transferred to them with higher success rates. On the other hand, inappropriate choices that are overstrained by their assignments will probably create a struggle to make the right decisions.

Strategic staffing leads the discussion to the insights of Paper 3. The different preferences for competency profiles of SCP&As that could not be explained by a broad spectrum of covariates raises the questions of whether companies have strategic staffing strategies in place. Apparently, selection criteria have been very subjectively driven. In order to assist hiring managers in the future to make more profound selection decisions on objective criteria, integrated workforce

planning, design and selection processes that involve HRM and SCM simultaneously are required. An integrated end-to-end process includes designing a job position, writing a job description, posting the advertisement, pre-selecting applicants, inviting qualified candidates, administering appropriate assessment tools and ultimately, identifying and hiring the best candidate using involvement of both functions (Stone, 2014).

5.4 Limitations and Future Research Opportunities

Naturally, the results of the three empirical studies are subject to certain theoretical and methodological limitations.

All data used in this dissertation is primary data, which were collected by the researcher(s) themselves for the purposes of the three studies. In contrast to large secondary databases containing panel data (e.g., Standard & Poor's Compustat financial database), the sample sizes are considerably smaller and only represent a specific population. In Chapter 2, we use cross-sectional data in which all variables were gathered with one survey. This common data collection procedure always embodies three main disadvantages. First, we are not able to analyze developments over time. Second, the timing of the snapshot is not guaranteed to be representative. Third, common method bias and endogeneity issues can never be entirely ruled out in single-informant surveys (Gujarati & Porter, 2009; Guide Jr. & Ketokivi, 2015), although all of our tests and remedy strategies suggest no interference of those threats. In response, future research could use pooled cross-sectional data (repeated surveys), longitudinal case studies or time-series and panel data analysis to study the impact of HRM practices on SCM over time, e.g., the development of SCM performance after (dis)investments in training.

In Chapter 3, we collected 307 resumes of SCEs working exclusively in Germany, Austria and Switzerland from the social network for business professionals, XING. Therefore, the insights

might not be generalizable to SCEs in other regions. Moreover, the analysis was limited to online affine individuals who possess a user profile on the particular platform, although the demographics report indicates a strong member base of 10 million users, and a high popularity among high-income jobs such as SCEs (XING, 2014, 2016). In response, future research could use resumes of international executives by gathering the data with questionnaires in order to target individuals who are not present in online social networks.

Due to the lack of research at the intersection of HRM and SCM, it was sometimes challenging to find a solid theoretical foundation for developing hypotheses. In the third chapter only three main research questions could be developed, which we explored. Similarly, in the fourth chapter, only two research questions could be elaborated on from the literature. However, in the second chapter we were able to develop testable theoretical grounded hypotheses. Hopefully, in the future after more interdisciplinary work on HRM issues in SCM is published, more theory-testing research can be conducted, as such research generally provides insightful and reliable results that lead to great theoretical and practical contributions (Schutt, 2015).

Reverting to Figure 1-1 *primary HRM activities and competitive advantage*, the three studies presented have clearly dealt with *managing employee competencies* activities. Naturally, this leaves opportunities for future research on *work design and work force planning* and *managing employee attitudes and behaviors* in a SCM context. Possible research focus could be the maturity of job design and description for SCM position. There is anecdotal evidence about “turf wars” between SCM and other departments which emerge due to a lack of clarity in terms of task ownership, functional spaces, and overlaps. This interference is driven by blurry work designs and firm-internal definition of the concept “SCM” in many companies (Mentzer, Stank & Esper, 2008). To resolve such issues, the HRM and SCM functions – with support of the senior

management – should jointly execute comprehensive job analysis projects to define clear responsibilities for SCM in exchange with the other functions.

Plenty of academic studies have been conducted on employee behavior, performance management, and compensation in management research (e.g., Allio, 2006; Barkema & Gomez-Mejia, 1998; Schweitzer, Ordóñez & Douma, 2004). Therefore, there should be generally a good understanding of *managing employee attitudes and behaviors* in theory and practice. However, due to the cross-functional uniqueness of the SCM function the management of attitudes and behaviors of various involved stakeholders is particularly challenging. For example, while the literature on incentive systems is voluminous, the linkage between incentives and SCM remains relatively unexplored in terms of covering the status-quo of collective goal and reward alignment of functions involved in the SCM process (Kahn & Mentzer, 1996; Simatupang & Sridharan, 2005). An interesting research problem could be the impact of misaligned, conflicting performance measures to evaluate employee performance. Particularly the linkage between procurement, production, planning and sales, which requires better integration and collaboration across operational boundaries, seems to offer great potential as these are often managed independently with neither vertically nor horizontally aligned performance goals and rewards (Simatupang & Sridharan, 2005). Although most HRM research is concerned with research on managerial employees, *employee benefits, health, and wellness* are major factors in recruitment and retention of blue-collar workers, in particular in transportation and warehousing that deserve further attention. Because of the unappealing working conditions such as physical demanding work in warehouses or long-haul road transports that force truck drivers to spend many nights away from their families, benefits and wellness levers are essential for making operational jobs in SCM more attractive (Kemp, Kopp & Kemp, 2013).

Due to the paucity of HRM research in SCM, this dissertation has used a broad definition of SCM for the early endeavor of this intersection. However, SCM is a concept that distinguishes between intra-firm SCM organizations and inter-firm SCM. Thus, future research could distinguish between both orientations to gain more in-depth insights about them. Fisher et al.'s (2010) already made useful suggestions how both orientations could be studied in the future: First, attention could be put on internal HRM activities that help organizations to achieve firm-specific goals. For instance, future papers could investigate how to attract qualified supply chain managers and develop them according to firm-specific needs. Second, studies could explore SCM-related HRM activities across company boundaries, such as joint coordination of HRM systems and diffusion of HRM best practices across the supply chain. There is the intriguing possibility that inter-firm strategic HRM systems could be predictors of supply chain outcomes and supply chain value: HRM can be used to create knowledge-sharing routines which are critical elements of successful supply chain collaboration (Dyer & Singh, 1998).

As a final motivation for more HRM-related research, I would like to highlight the exclusively positive feedback by supply chain professionals across all hierarchical levels, countries, and industries that we received during dozens of interviews, online surveys and experiments over the last four years. Almost everybody getting in touch with us expressed the need and appreciation for conducting practice-relevant HRM research in SCM. As our research community should certainly listen to practitioners to find and tackle real life SCM problems, further research on the people managing supply chains should be pursued.

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