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Supply Chain-Driven Innovation: The Influence of Supply Chain Resource Orchestration on Organizational Performance

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To the Graduate Council:

I am submitting herewith a dissertation written by Ulrich Schmelzle entitled "Supply Chain-Driven Innovation: The Influence of Supply Chain Resource Orchestration on Organizational Performance." I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Business Administration.

Wendy L. Tate, Major Professor

We have read this dissertation and recommend its acceptance:

Christopher W. Craighead, Chad W. Autry, David W. Williams

Accepted for the Council:
Dixie L. Thompson

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

Supply Chain-Driven Innovation: The Influence of Supply Chain Resource Orchestration on Organizational Performance

A Dissertation Presented for the

Doctor of Philosophy

Degree

The University of Tennessee, Knoxville

Ulrich Schmelzle

August 2017

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Dedication

This dissertation is dedicated to my wife Karen, my sons Jan-Niklas and Mark Hendrik, and my friends Jack and Cindy Koelsch.

Abstract

As continuous innovation became a strategic necessity in many markets, organizations are increasingly adding external resources to complement their in-house R&D activities. However, little is known about the concrete practices of employing and integrating those external resources. Hence, this research introduces a new conceptual framework of supply chain resource orchestration (SCRO) on the basis of a systematic literature review and a theory elaboration of resource management theories. Qualitative interviews with supply chain managers in a multi-case study are enriching and substantiating the SCRO conceptualization. Finally, a cross-sectional survey (n= 247) is applied to empirically validate the new framework. The positive effects of SCRO on innovation and financial performance are confirmed. As a theoretical contribution, this research bridges supply chain and innovation management literature streams to enhance the understanding of essential resource management practices, their performance consequences, and implications of organizational culture on such relationships. This research extends the domain of resource orchestration theory to supply chain phenomena and the open innovation context. Directions for future research are proposed along with several theoretical and managerial implications.

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CHAPTER ONE – INTRODUCTION

Introduction

During 18 years of managerial industry experience, the author has witnessed a number of new product development (NPD) projects primarily in the aerospace and semiconductor industries. In different settings, he experienced supply chain management (SCM) as a relevant contributor to and critical driver of an organization's innovation activities. Innovation can be broadly understood as implementing new ideas to enhance organizational value creation (Linder, Jarvenpaa, & Davenport, 2003) and refers to product, service, and process enhancements. Innovation has evolved into a strategic imperative for long-term survival in many market environments (Heidenreich & Kraemer, 2016).

Effective supply chain management has the potential to drive innovation in the organization and help to avoid costly failures (Bruce, Daly, & Kahn, 2007). To date, however, many NPD initiatives are not yet resulting in commercially successful products or services, and researchers have noted a failure rate of around 50% in various markets (Wowak, Craighead, Ketchen, & Hult, 2016). How can the success rate of innovation be increased, and what is the role of SCM in supporting this strategic innovation objective (Krause, Pagell, & Curkovic, 2001)? This leads to the question of how supply chain managers can better support the innovation activities to minimize failures and enhance innovation performance.

Both scholars and practitioners have come to realize that in many competitive market environments, companies can no longer rely on the traditional new product development doctrine with a focus on internal, protected R&D activities (Gassmann, Enkel, & Chesbrough, 2010; Oke, Prajogo, & Yayaram, 2013). To save development costs and enhance time to market, organizations increasingly need to utilize existing solutions from their supply chain (Wagner, 2010; Wowak et al., 2016). Chesbrough (2003) succinctly noted that there are smart people

outside of the focal organization, providing the reasoning for shared, cooperative innovation and knowledge sharing between the focal firm and key suppliers. Consequently, supply chain managers need to plan, organize, and control the inflow and integration of key supply chain resources more effectively and efficiently than in the past and develop new capabilities accordingly (West & Bogers, 2014).

Supply management is increasing in complexity as it also involves the sourcing of essential, specialized knowledge, meaning ideas and solutions, to support the company-internal innovation process (Yli-Renko, Autio, & Sapienza, 2001). Furthermore, this new, extended resource management task includes not only the acquisition but also the effective integration of tacit knowledge from upstream supply chain partners (Allred & Swan, 2014; Leiponen & Helfat, 2010). Thereby, supply chain-driven innovation phenomenon encompasses the acquisition, integration, and exploitation of innovative knowledge from the supply network.

Although there is a long tradition of investigating supplier involvement in NPD projects (Cousins, Handfield, Lawson, & Petersen, 2006; Schoenherr & Swink, 2012; Song & Di Benedetto, 2008), little empirical research has investigated the detailed resource management actions and practices related to supply chain resources and the critical interplay with cultural factors (Barney, Ketchen, & Wright, 2011; Ketchen, Wowak, & Craighead, 2014; Sirmon, Hitt, Ireland, & Gilbert, 2011). This dissertation is intended to provide a better understanding of the relevant supply chain resource management practices. The research focuses generally on how resource management practices influence innovation and financial outcomes of the organization. Specifically, the study introduces and investigates the emergent concept of supply chain resource orchestration (SCRO), which describes the process of managing the acquisition, integration, and

exploitation of critical external resources with the purpose of creating value for the end customer (Hitt, Ireland, Sirmon, & Trahms, 2011; Sirmon et al., 2011; Wowak et al., 2016).

Extant research on the topic of resource management to support innovation has focused on the characteristics of resources (i.e., valuable, rare, inimitable, nonsubstitutable) (Kozlenkova, Samaha, & Palmatier, 2014) or on the resource management and asset orchestration of internal resources (Sirmon & Hitt, 2003). However, current research has been relatively silent about the management of external resources (Hansen, Perry, & Reese, 2004; Ketchen et al., 2014), and how such resources from the supply chain should be effectively and efficiently be managed (Hitt et al., 2011).

Unexplored research areas include a deeper comprehension of the micro-processes and sub-processes of resource management (Sirmon et al., 2011). Overall, more research appears warranted in terms of resource management beyond a firm's boundaries (Crook & Esper, 2014) to add theoretical breadth and depth and explore the boundary conditions at the intersection of supply chain management and innovation literature streams.

Research Objective

The objective of this dissertation lies in investigating supply chain resource management practices and how those could facilitate and enhance innovation and financial performance. Hence, this dissertation research introduces and develops a conceptual framework of supply chain resource orchestration, analyzes the interplay with organizational culture, and collects empirical evidence from interviews with supply chain managers to complement the conceptualization. Supply chain resource orchestration sub-processes encompass the balanced

practices of structuring, bundling, and leveraging supply chain resources to create customer value and achieve organizational performance. The dissertation research attempts to address research gaps of the extant resource management theory by extending its theoretical domain at the intersection of supply chain and innovation management research streams. Consequently, the impact of effective resource management practices, orchestrating supply chain resources, will become better understood.

The purpose of this dissertation is to explore the performance impact of supply chain resource orchestration and understand how supply chain managers can enhance the innovation performance of their organization.

Research Questions

This dissertation research is guided by the following research questions:

- How can supply chain management decision-making and practices enhance the organizational performance?
- How does supply chain resource orchestration influence the innovation and financial performance of the organization?

Overview of Research Approach

The dissertation research is structured in three complementary research studies with specific methodologies, addressing different research questions related to the overarching topic of supply

chain-driven innovation, or supply chain management supporting the organization's innovation activities. Each of the three studies will focus on complementary aspects related to the management of supply chain resources and the organizational (innovation and financial) performance implications of supply chain management.

Study One

The main motivation for this dissertation research is to enhance the conceptual understanding of how supply chain management can enhance the innovation performance of an organization. One essential aspect is to investigate the relevant processes and sub-processes of sourcing external resources for the organization. Therefore, the first study concentrates on the concept of innovation sourcing, which involves the acquisition and integration, rather than internal development, of critical knowledge from external providers. A systematic literature review methodology is applied to synthesize the current theoretical body of knowledge on this phenomenon. Current research concerning innovation sourcing is fragmented and researchers use numerous different, partially conflicting terminology.

Such fragmentation and the use of overlapping, unique definitions prevent the development of a consistent body of knowledge and limits the theoretical advancement of the field (Autry, Rose, & Bell, 2014). Hence, this systematic literature review study synthesizes the current body of knowledge on innovation sourcing. The study leads to a conceptualization of how innovation sourcing and its main dimensions are linked to innovation performance. A theoretical model addressing the key dimensions of innovation sourcing, research propositions, and a detailed agenda for future research are concluding this first dissertation study.

Study Two

As indicated in the research agenda of study one, the influence of SCM on innovation performance stretches beyond the traditional purchasing domain and extends to both the strategic management and the operational level involving cross-functional practices and work routines. Therefore, the research focus is broadened during the second study.

The second study focuses on the more encompassing phenomenon of supply chain resource management, involving specifically the acquisition and integration of external resources. Specifically, the research study is introducing a theoretical framework of supply chain resource orchestration. Grounded in the resource-based theory (Barney, 1991), the study entails a theory elaboration of resource orchestration theory (Sirmon et al., 2011) to extend its theoretical domain. The research follows the methodological guidance of Wacker (1998) and Ketokivi & Choi (2014). The understanding and definition of key variables, theoretical domain, conceptual relationships, and predictions of supply chain resource orchestration are developed based on the literature.

Next, research interviews from a multi-case study are analyzed to add the perspectives of practitioners and substantiate and enrich the SCRO framework, linking practice and theory (Craighead, Ketchen, & Cheng, 2016). Finally, a number of concrete SCRO practices related to the structuring, bundling, and leveraging of supply chain resources are summarized and presented.

Study Three

Finally, the new SCRO framework, developed in the prior study, is subsequently empirically tested in study three. A cross-sectional survey involving 247 supply chain managers is utilized to

assess the new conceptualization and specifically the performance impact of supply chain resource orchestration. As part of the SCRO framework, the moderating influence of cultural factors (operationalized with the entrepreneurial orientation construct) on the relationship between SCRO and organizational performance is tested as well. The method of structural equation modeling (SEM) is applied in AMOS 24 involving both confirmatory factor analysis (measurement model) and a causal path analysis (structural model).

Expected Contribution

The supply chain-driven innovation phenomenon relates to a number of different academic fields. Hence, this dissertation research is expected to contribute an integrative perspective to several complementary research streams including supply chain management, marketing, innovation, and strategic management.

First, based on the theory elaboration method, the resource orchestration theory is extended and broadened within the domain of supply chain and innovation management. A conceptual framework of supply chain resource orchestration is developed as a theoretical contribution. The subsequent data triangulation with empirical case study data and the categorizing of the SCRO sub-processes has enriched and substantiated the new framework as a theoretical contextualization of resource management theories (Craighead et al., 2016).

Second, the literature review has revealed the need to gain a better understanding of the detailed, micro-level supply chain resource orchestration practices. Hence, the multi-case study is providing a rich and interesting perspective from supply chain managers describing concrete SCRO practices. Moreover, demonstrating the important interplay between organizational

culture, particularly innovation culture, and the SCRO practices is another relevant contribution. The research is a first step in gaining a deeper understanding of how external resources are orchestrated and integrated.

By drawing on findings from the innovation management and entrepreneurship literature streams, this research has extended the body of knowledge in supply chain management at this intersection. The dissertation research responds to calls for more research on resource management focusing on external resources, leaving the organization's boundaries (Crook & Esper, 2014).

For supply chain managers, the research findings should provide valuable guidance toward the performance impact and importance of concrete resource management practices. Depending on their individual market environment, managers can place more or less emphasis on specific sub-processes, refine specific practices, and enhance the balance among those activities. The interplay between SCRO practices and organizational culture is investigated and demonstrated revealing interesting effects and practical implication in varying environments.
By providing an overview of concrete managerial actions of orchestrating external resources, managers should gain a better understanding of the phenomenon. Possibly, this might support managers in reducing the failure rates of innovation projects.

The dissertation research provides interesting managerial findings in regards to the necessary balancing and synchronization of the SCRO practices, which could serve as guidance for supply chain managers. The case companies of the case study demonstrated little attention to resource divesture activities and overall relatively little (with exception) emphasis on effective leveraging and commercialization practices. All case companies showed distinctive strengths and weaknesses that can assist practitioners with developing best practices recommendations. The

overall theoretical and practical contributions and implications along with some research limitations will be further discussed in the concluding Chapter Five.

Dissertation Organization

This dissertation is structured into five chapters. In Chapter One, the dissertation is introduced and the research motivation, research objectives, and individual research studies are described.

Chapter Two encompasses a systematic literature review on the first topic of innovation sourcing. This study provides an in-depth overview of the theoretical foundational on which the subsequent dissertation research can build on. Important gaps in the extant literature are identified and a detailed future research agenda concludes that chapter.

In Chapter Three, the main theory explaining and predicting supply chain resource management is analyzed using a theory elaboration methodology. On that foundation, the emergent supply chain resource orchestration framework is introduced in a conceptual model. This theory-based conceptualization is enriched with the perspective of supply chain managers that participated in a multi-case study. A qualitative cross-case analysis of the interview data led to the emergence of detailed supply chain resource orchestration practices that were categorized and structured.

In Chapter Four, the results of a cross-sectional survey and structural equation modeling methodology are presented. This study is based on a quantitative research design with the focus on testing the new supply chain resource orchestration framework introduced in the prior Chapter Three.

Finally, Chapter Five concludes the dissertation by summarizing and integrating the findings from the three studies, addressing limitations and implications, as well as offering suggestions for further research on this phenomenon.

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CHAPTER TWO – ARTICLE 1: SYSTEMATIC LITERATURE REVIEW

This chapter is revised based on a paper by Schmelzle, U., & Tate, W. L., which has been accepted for publication:

> Schmelzle, U., & Tate, W. L. (forthcoming). Integrating External Knowledge: Building a Conceptual Framework of Innovation Sourcing. *Transportation Journal*, *56*(4).

The author of this dissertation has been the lead author of the accepted paper. His responsibilities included the research design, data collection, data analysis, conceptualization of the innovation sourcing model, development of a research agenda, manuscript writing, and communication with editors and reviewers. His committee chair served in an advisory role and provided feedback during the various research stages.

Abstract

Innovation sourcing is the acquisition and integration, rather than internal development, of critical knowledge from external providers. In many markets, innovation sourcing has become critical for long-term survival. Consequently, sourcing processes are applied to complement internal design capabilities with external knowledge. The literature addressing innovation sourcing aspects is largely fragmented, which limits the theoretical understanding of the phenomenon. This dissertation chapter presents a systematic literature review that synthesizes the body of knowledge regarding innovation sourcing, derives a conceptualization of the specific innovation sourcing dimensions, and relates it to innovation performance outcomes. A conceptual model, key dimensions and an agenda for future research are significant results of this study.

Introduction

Many scholars agree that continuous innovation has become a strategic imperative for many organizations today (Heidenreich & Kraemer, 2016; Wowak, Craighead, Ketchen, & Hult, 2016). The market pressure is succinctly characterized by the motto of "innovate or die" (Quinn 2000). More than 50 percent of current sales are based on recently introduced products or services in many markets, (Schilling & Hill, 1998). Hence, innovation is a strategic driver of growth (Calantone & Di Benedetto, 2012). In this dissertation, innovation is defined as new or refined methods, products or practices that lead to higher organizational performance (Flint, 2006; Gatignon & Xuereb, 1997). Prior research has shown that successful innovation can lead to increased market share and profits due to relevant product or service enhancements (Luca & Atuahene-Gima, 2007).

Nowadays, collaborative development activities with suppliers are a fundamental driver of innovation (Rothaermel & Alexandre, 2009; Stock & Tatikonda, 2008). Organizations increasingly rely on the support from external partners (Kostopoulos, Papalexandris, Papachroni, & Ioannou, 2011) to meet the required development speed and quality (Rosell & Lakemond, 2012). In Europe, for example, external research and development (R&D) spending is more than 50% of the total in-house R&D budget for some organizations (Gassmann, 2006). A similar trend has been observed in the U.S. (Slowinski, Hummel, Gupta, & Gilmont, 2009), so that half of the innovation 'value' is sourced from or jointly developed with external organizations, and this phenomenon is termed innovation sourcing.

Organizations attempt to acquire critical knowledge from external partners and incorporate that knowledge into their product or service development to meet customer value

expectations and improve organizational performance. The goal of innovation sourcing is to obtain and apply innovative knowledge from external constituents to enhance the product and service portfolio, and ultimately gain market share and improve profits. Innovation sourcing is defined as the acquisition and integration of beneficial knowledge from the supply base to enhance the company's innovation performance (Schmelzle and Tate, forthcoming).

Innovation sourcing enhances organizational development activities by seeking knowledge from the upstream supply chain. Knowledge relates to beneficial ideas and solutions that can be applied to products, services and process enhancements. However, the phenomenon of innovation sourcing appears under-researched to date. Besides, innovation sourcing research is fragmented and incomplete. Scholars do not sufficiently relate to prior findings and disagree about essential definitions. One indication is the use of deviating terminology such as innovation sourcing (Linder, Jarvenpaa, & Davenport, 2003), technology sourcing (Allred & Swan, 2014; Sabidussi et al., 2014), knowledge sourcing (Kang & Kang, 2009; Leiponen & Helfat, 2010), knowledge transfer and application (Bierly, Damanpour, & Santoro, 2009), knowledge integration (Revilla & Villena, 2012), and knowledge acquisition (Cassiman & Veugelers, 2006). In this dissertation research, the author develops a holistic term for innovation sourcing to streamline the fragmented literature.

Open innovation is a related concept to innovation sourcing and refers to the inflow and outflow, use, and commercialization of ideas and technologies for organizations (Chesbrough, 2003). Open innovation is much broader in scope than innovation sourcing. The latter refers to specific practices, including the active search for applicable external knowledge and its subsequent integration, combining internal and external information to create new, innovative solutions for product, service, or process enhancement (Linder et al., 2003). Innovation sourcing

focuses specifically on the upstream acquisition of knowledge whereas the emphasis of open innovation literature has been on joint development with downstream constituents, the co-creation and co-development activities with external market participants, such as customers and/or end users (Gassmann, Enkel, & Chesbrough, 2010).

There have been calls for research on how supply chain management can support innovation efforts (Brattström & Richtnér, 2014; Clausen, 2013). This dissertation responds to those calls by focusing on the innovation sourcing concept, which encompasses the knowledge inflow from suppliers and its effective integration. By clarifying the key dimensions of innovation sourcing and relating the construct to innovation performance, this study might add in addressing a noticeable knowledge gap.

A comprehensive literature review is the appropriate method for establishing an "initial or preliminary conceptualization" of an unexplored phenomenon (Gligor & Holcomb, 2012, p. 439). Hence, the overarching objective of this dissertation research is to perform a systematic literature review that synthesizes the current but fragmented scholarly knowledge regarding innovation sourcing and the corresponding performance impact. A critical necessity for the theoretical development of a field is to achieve a minimal degree of consensus regarding the main dimensions of the core constructs (Autry, Rose, & Bell, 2014; Combs, Crook, & Shook, 2005; Venkataraman & Grant, 1986). Therefore, this dissertation focuses on the main underlying dimensions of innovation sourcing to derive a conceptual model and a foundation for future research. It is directed by three research questions:

RQ1: What are the key dimensions of innovation sourcing?

RQ2: How is innovation sourcing related to innovation performance?

RQ3: What future research issues should be addressed to enhance the understanding of the innovation sourcing phenomenon?

First, the essential literature on innovation sourcing is synthesized to establish a foundation for the subsequent model and proposition development. This dissertation chapter concludes with suggested future research.

Innovation Sourcing and Innovation Performance

In many organizations, innovation is primarily driven by internal activities, championed by the in-house R&D or commercialization departments. However, this internally focused "design-it-yourself" mentality (Cantarello, Nosella, Petroni, & Venturini, 2011; Gassmann, 2006) is arduous and neglects external knowledge from the supply network, limiting competitiveness. Similar to the global division of labor in manufacturing and logistics, research and development activities are increasingly shared cooperatively among supply network partners (Chesbrough, 2006; Rigby & Zook, 2002). Joint innovation collaboration has become essential because of increasing product, service, and process complexity (Chesbrough & Crowther, 2006; Enkel, Gassmann, & Chesbrough, 2009).

The innovation sourcing process involves constant scanning for new ideas in methods, products or practices from upstream supply chain members. With innovation sourcing, organizations are acquiring relevant knowledge from a collaborative network of various suppliers supporting the focal firm (Chesbrough, 2003; Gallego, Rubalcaba, & Suárez, 2013; Powell, Koput, & Smith-Doerr, 1996). An organization's formal boundaries are converted "into a more semi-permeable membrane that enables knowledge to move more easily between the

external environment and the organization's internal innovation process" (Gassmann and Enkel, 2004, p. 2). The sourcing of external knowledge enables the company to strategically share development risks and costs with other organizations (Chesbrough & Crowther, 2006).

Innovation Performance Definitions and Operationalization

Inter-firm innovation can lead to better innovation performance such as shorter development times (Di Benedetto, 1999; Rothwell, 1994) or lower costs (Chesbrough, 2006). Scholars have applied numerous different definitions and measures to capture innovation performance. Table 1 depicts the four main dimensions of innovation performance definitions and provides corresponding sample definitions from the literature. Either single or multi-dimensional definitions have been applied. Based on the literature review, innovation performance was mainly defined in terms of market performance (Dimension A) and/or product and service performance (Dimension B), and some scholars defined the concept in both of those directions. Less frequent was the use of financial (Dimension C) and process performance (Dimension D) for the definition of innovation performance.

Similar to the diversity of definitions, researchers are measuring innovation performance in numerous different ways. In Appendix 3, the diverse construct operationalization of innovation performance applied in supply chain management (and related fields) is summarized. For example, some scholars measure innovation performance relative to internal targets for new products and services (Nakata & Im, 2010). Alternatively, market performance (e.g., sales volume, market share, and number of product/service introductions) or financial performance (e.g., profitability) have been utilized in the literature as measures (Knudsen & Mortensen, 2011; Yuen & Thai, 2016). Other researchers have assessed process performance, product and service

Table 1
Main Definitions of Innovation Performance

Dimension A	Dimension B	Dimension C	Dimension D
Market Performance (e.g., Sales, Sales Growth, Number of Product/ Service Introductions, Customer Satisfaction)	**Product and Service Performance** (e.g., Functionality, Quality, Service Effectiveness, Technical Advancement)	**Financial Performance** (e.g., Profitability, Return on Investment, Return on Assets)	**Process Performance** (e.g., Development Cycle Time, Effectiveness of Workflows, Practices, and Routines)
Innovation Performance: A firms' turnover attributable to technologically improved or new products (Tsai & Wang, 2009)		**Innovation Efficiency**: The resources in terms of time and cost required to complete the innovation project (Wagner, 2010)	**Innovation Performance**: The extent to which firms are satisfied with the achievements in their development and implementation of innovation activities (Chen & Huang, 2009)
Innovation Success: The commercial performance of a new product, measured by perceived measures such as the degree to which the new product's objectives have been achieved, which are relative to competition and expectation within the industry (Gatignon & Xuereb, 1997)			
Service Innovation Performance: The introduction of new services that are created based on new knowledge or technology, are definitely different or greatly improve the existing services in terms of the technological aspects, customer relations, or other features (Kang & Kang, 2014)			
New Product Performance: The degree to which a product achieves goals originally established by the firm for the product, for example, in terms of customer satisfaction, technological advancement, and overall product performance (Nakata & Im, 2010)			
Innovation Effectiveness (Innovativeness): The degree of newness of an innovation with highly innovative products on one side of the continuum and low innovative products on the opposite side of the continuum (Wagner, 2010)	**New Product Performance**: The new product's profitability, market share, and growth performance benefits from highly effective and efficient innovation project outcomes (Wagner, 2010)		
	New Product Performance: Lower costs, higher quality, or speed to market either compared to the firm's own usual resource requirements, expectations, or the norm in the industry (Knudsen & Mortensen, 2011)		

performance (e.g., functionality and quality), and technological achievements (e.g., patents) (Chen, Lin, & Chang, 2009; Marsh & Stock, 2006). Therefore, further measurement scale harmonization appears warranted (Autry et al., 2014). In this dissertation research, innovation performance is defined holistically as the extent of how well a company has implemented processes or commercialized new ideas in their product/service offerings. To conclude: Organizations are acquiring relevant new knowledge from their upstream supply chain to improve their products, services, and processes and thereby strengthen their competitiveness.

Methodology

In this dissertation, the author follows a systematic literature review methodology, which is an suitable approach to identify theoretical gaps and conceivable research inconsistencies impeding the further development in the field (Keupp & Gassmann, 2009). Previous research has suggested five distinct stages in performing a systematic literature review (Fischl, Scherrer-Rathje, & Friedli, 2014). This research is following those stages in a systematic, transparent way to minimize the risk of bias and support a potential study replication.

- Stage One – Definition of Scope
- Stage Two – Topic Conceptualization
- Stage Three – Literature Search Execution
- Stage Four – Article Analysis and Model Conceptualization
- Stage Five – Future Research

Stage One – Definition of Scope

The scope is defined based on the following premises:

- **Focus**: The research focus lies on deriving both a theoretical contribution and practical implications.
- **Goals**: The goal of this research is to enhance the understanding of the dimensions of innovation sourcing and its relationship to innovation performance, to synthesize the current empirical literature focusing on this topic, and to develop a future research agenda.
- **Organization**: This research is following a systematic literature review methodology
- **Perspective**: The authors' position on this research is neutral and not pre-conceived.
- **Audience**: This research is intended for the scholarly community (either supply chain-specialized or general) and the research findings will be published in an academic journal.
- **Coverage**: This dissertation research is based on a representative coverage strategy. This refers to the degree to which relevant articles are considered in this literature review. Following Fischl et al. (2014), a representative coverage strategy was chosen because an exhaustive approach appears unfeasible in light of the characteristics of the knowledge base which is noticeably growing, widely dispersed, and of a cross-disciplinary nature.

Stage Two – Topic Conceptualization

This dissertation research is intended to contribute to the scholarly debate about how sourcing processes might enhance innovation performance of a company. It centers on the concept of

innovation sourcing, its critical dimensions, and its impact on innovation performance. Innovation sourcing deals with finding new knowledge from external suppliers and integrating it to enhance its portfolio of product, service, and processes. Innovation sourcing necessitates combining and assimilating the newly acquired external knowledge with the existing internal knowledge base.

Stage Three – Literature Search Execution

The concept of innovation sourcing relates to the fields of supply management, strategic management, marketing, innovation/technology management, engineering, and entrepreneurship. Hence, the author selected EBSCOhost (business source complete) database as it addresses all relevant academic fields extensively, and has been applied by similar systematic literature reviews on boundary-spanning topics (Fischl et al., 2014; Gligor, 2014). EBSCOhost is considered one of the most extensive databases in management (Gligor, 2014; Tachizawa & Wong, 2014). Furthermore, Google Scholar (GS) and Science Direct (SD) were used to enable a broad coverage of relevant literature.

What timeframe should be covered in the literature search? In 2003, Chesbrough published his seminal book on open innovation (Chesbrough, 2003). At that time, he referred to an emerging conversation among scholars and practitioners about capturing external knowledge for the focal firm. Quinn, another significant scholarly driver in this emerging field, published a seminal article about outsourcing innovation as the new growth engine in 2000 (Quinn, 2000). Therefore, the year 2000 is used as the foundational year for innovation sourcing in this literature review. Due to research purpose and target audience, the data collection is based on peer-reviewed scholarly journals but not practitioner-based journals (Gligor & Holcomb, 2012) to

benefit from the rigor of the prior review process, which ensures a higher quality result (Newbert, 2007). Only peer-reviewed academic journals in English were considered. Editorials, book reviews, conceptual papers, and literature reviews were excluded (Fischl et al., 2014).

According to Seuring and Gold (2012), the two most common approaches of literature reviews in the SCM domain are (1) title, abstract, keyword searches or (2) a focus on selected journals (determined a-priori). The author selected the former in order to avoid a potential pre-mature exclusion of relevant articles by narrowing the search to specific journals a-priori. Such an approach is better accounting for the multi-disciplinary breadth of the topic by covering articles from related fields in the search (Seuring & Gold, 2012). The first activity was to define the keyword strings (Pashaei & Olhager, 2015), which were sourc*, innovat*, strateg*, and purchas*. The results were compiled, compared, and sorted to identify potential duplications. This step yielded 538 published articles, with a search time horizon of January 2000 to March 2015. Next, the titles and keywords of each article were verified to ensure a fit to the research question. In case of doubt, the article was kept to have a rather extensive (inclusive) literature foundation. Consequently, 242 articles remained in the pool for the next step of abstract screening.

After the initial screening (duplicate removal; title and key word screening; abstract screening), a total of 118 articles remained potentially relevant for the subsequent analysis. In the concluding screening step, all remaining articles were read completely, assessed, and categorized according to type (empirical, conceptual), topic, context, main theoretical frameworks, critical definitions, methodology, methodological rigor, main constructs (independent and dependent variables) and contribution/findings. This step included an assessment whether the article matched the scope and purpose of this study. At this stage, the author decided to solely focus on

empirical work following (Newbert, 2007). The detailed inclusion and exclusion decision-making steps and criteria are described in the Appendix. The analysis results and categorization decisions were iteratively reviewed until common categories emerged (Miles & Huberman, 1994). In this final screening, a number of articles were identified as not fitting with the overall research purpose (only partial fit or peripheral coverage), lacking a solid theoretical foundation, or showing methodological weaknesses. In addition, some articles were considered to be redundant because other papers of the sample were more comprehensive. This final screening step reduced the number of papers from 118 to 30 papers (Table 2).

Article Analysis and Conceptual Development

The final two stages are the main stages in the systematic literature review and therefore both Stage Four (article analysis and model conceptualization) and Stage Five (future research) are included in separate sections. This section will entail the main conceptual development of the innovation sourcing framework. Based on the literature review, innovation sourcing is a multidimensional, formative construct. It is primarily formed by external knowledge integration, internal knowledge integration, and innovation orientation (Figure 1).

External Knowledge Integration

External knowledge integration practices are a key dimension of innovation sourcing. External integration is defined broadly as a focal firm's cooperation with external partners (Schoenherr & Swink, 2012). In contrast, external knowledge integration refers to the effective application and exploitation of externally-provided knowledge for the benefit of product, service, or process

Table 2
Article Screening

Step	**1**	**2**	**3**	**4**
Activity	Duplicate Removal	Title and Key Word Screening	Abstract Screening	Analysis of Full Articles
EBSCO	425	169	72	19
SD	73	46	31	7
GS (*)	40	27	15	4
Article Count	**538**	**242**	**118**	**30**

(*) *The Google Scholar list was limited to the first 100 hits*

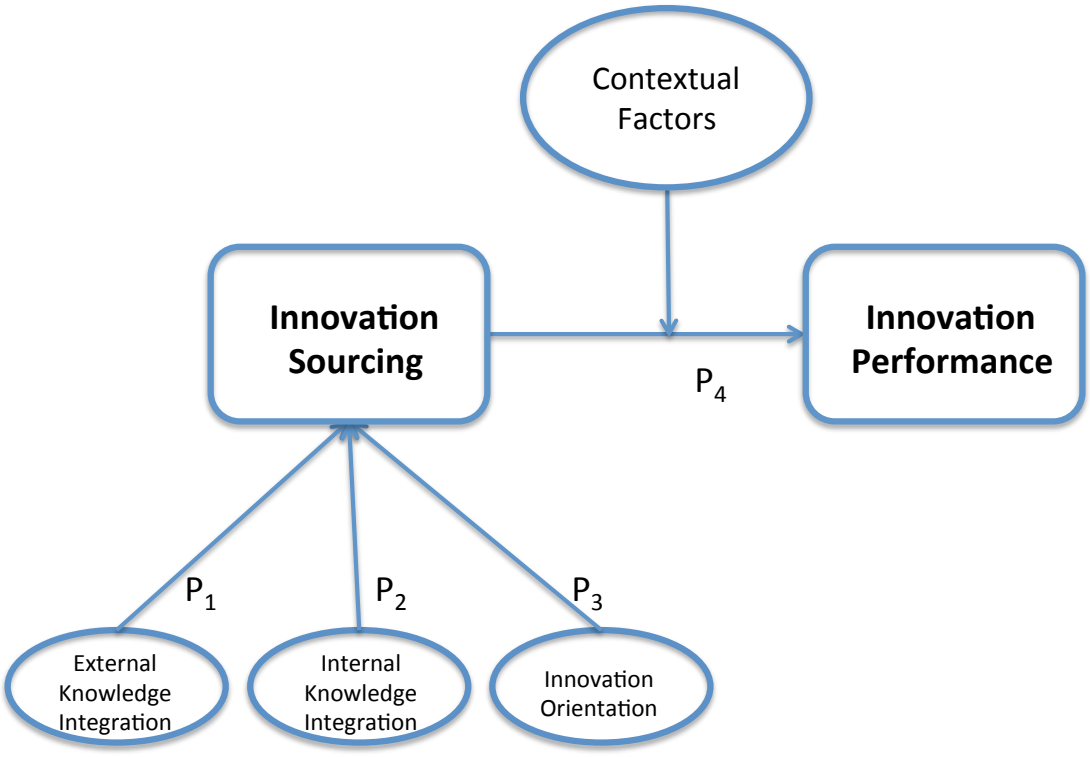

Figure 1 - Conceptual Framework

enhancements (Gallego et al., 2013; Slowinski et al., 2009; Teece, 2007). The latter definition is less broad and concentrates on the integration of intangible input (e.g., ideas), while the former is a much broader, strategic concept of the inter-organizational collaboration literature. The practices and processes of external knowledge integration were categorized into three areas. The first represents the searching, scouting, or scanning practices. The second concerns external collaboration and knowledge exchange. The third category addresses the interactive learning process to integrate the external knowledge in the company.

Searching, Scouting, and Scanning

An important aspect of external knowledge integration relates to the knowledge acquisition from external entities (Cassiman & Veugelers, 2006) and its influence on internal information processing and knowledge exploitation processes. The searching, scouting, and scanning process involves a set of organizational practices with the purpose of monitoring the market development and recognizing when opportunities evolve that offer potential benefits for the company. This includes the practice of nurturing external links to various new entities in formal or informal arrangements to gain access to critical knowledge, and of establishing a scouting mechanism to enhance awareness of industry trends (Chen, Chen, & Vanhaverbeke, 2011).

According to Eisenhardt and Santos (2002), multiple knowledge searching and acquisition mechanisms exist (e.g., probing processes (experimental products) or advice networks). Overall, organizations continuously scan their environment and attempt to acquire critical knowledge, which is not available in-house.

External Collaboration and Knowledge Exchange

In contrast to the first category, which included establishing fresh new ties to organizations outside of the established supply base, the second category emphasizes practices of building collaborative, strong ties to existing suppliers. Collaboration with innovative organizations is essential for maintaining an up-to-date knowledge repository for the company (Bierly et al., 2009). Effective network collaboration has proven to be decisive for innovation performance in a particular context such as high-velocity environments (Eisenhardt & Santos, 2002), but it requires adequate knowledge integration practices (Gallego et al., 2013). Scholars have emphasized that effective integration practices focus on the orchestration of collaborative inter-organizational knowledge exchange and on enabling the effective and efficient in-house utilization of this newly obtained knowledge (Revilla & Villena, 2012).

The development of a collaboration capability (collaborative know-how) to facilitate the knowledge exchange among respective constituents is critical (Bierly et al., 2009). This includes effective collaborative practices of creating, maintaining, and utilizing the necessary communication channels with a network of suppliers (Gallego et al., 2013). Moreover, the resource allocation among external partners needs to be organized effectively in a collaborative manner (Powell et al., 1996). Apart from the use of formal network connections such as alliances, researchers have identified complementary practices such as informal research collaborations (Gallego et al., 2013). In complex and dynamic environments such as biotechnology, establishing boundary-spanning networks with informal relationships facilitates the acquisition of external knowledge and the subsequent knowledge exchange between the focal firm and research laboratories or universities (Liebeskind, Oliver, Zucker, & Brewer, 1996).

Interactive Learning

Interactive learning practices influence the success of knowledge integration (Azadegan & Dooley, 2010). Learning can be understood as a process of accumulating knowledge for the company. Scholars have characterized learning practices as being experience-driven and focused on enhancing organizational routines (Eisenhardt & Santos, 2002) and the organization's knowledge repository (Cohen & Levinthal, 1990). Looking at industries characterized by complex, expanding, and dispersed knowledge, research suggests that innovation is originating from networks of learning rather than individual firms (Powell et al., 1996). Hence, the innovation sourcing process involves not solely the acquisition of "finished" knowledge from suppliers but rather implies effective learning processes (Manuj, Omar, & Yazdanparast, 2013). In this regard, learning mechanisms form the essential operational routines for the innovation process (Jiang, Waller, & Cai, 2013; Oke & Kach, 2012). Inter-organizational learning practices might be understood as a critical enabler for creating new organizational capabilities, resulting in a competitive advantage (Manuj et al., 2013; Marsh & Stock, 2006).

How does interactive learning facilitate the companies strive for innovation? For example, effective learning practices should assist in integrating knowledge more quickly and effectively and thus enhance the knowledge assimilation and retention capabilities (Marsh & Stock, 2006). Essential aspects include operational routines to capture relevant knowledge, which then facilitates the internal knowledge absorption and exploitation process (Abecassis-Moedas & Mahmoud-Jouini, 2008; Zahra & George, 2002). Overall, three practices of external knowledge integration were introduced. This cross-organizational integration with various providers of valuable, non-redundant knowledge can be understood as a fundamental dimension

of the innovation sourcing concept. In summary, all three external knowledge integration practices positively influence innovation sourcing, which leads to the first research proposition:

Proposition P_1: External knowledge integration is positively associated with the level of innovation sourcing.

Internal Knowledge Integration

Internal knowledge integration refers to two main categories. The first is an internal knowledge absorption process, and the second is knowledge resource management and cross-functional integration. While innovation sourcing from various external sources is an increasing trend (Linder et al., 2003), organizations need to maintain a sufficient level of internal R&D capabilities in-house (Tsai & Wang, 2009). Firms cannot simply acquire only external knowledge (Chen et al., 2011). External and internal knowledge integration activities are complementary (Cassiman & Veugelers, 2006). On one hand, external technology sources might lack the essential "local or contextual knowledge of markets, supply chains, and organization specific factors" (Tether & Tajar, 2008). On the other hand, the focal firm needs to maintain the capabilities of evaluating the external knowledge and then amending its internal technological base through effective knowledge integration practices (Marsh & Stock, 2006). This adaptation necessitates an effective knowledge integration competence (Bierly et al., 2009).

Knowledge Absorption

In the literature, absorptive capacity (Cohen and Levinthal 1990) and its critical impact on innovation performance have been empirically validated (Laursen & Salter, 2006). Researchers

have described the internal skills of effectively exploiting the externally acquired knowledge (Cassiman & Veugelers, 2006), including the capability to create more sophisticated knowledge combinations from different sources (Chesbrough, 2003). Others have emphasized the internal capability of retaining and refining available knowledge for future use (Marsh & Stock, 2006). Overall, the essential internal knowledge integration capability encompasses the corresponding routines and administrative processes that facilitate the integration and utilization of knowledge (Roper, Du, & Love, 2008).

Knowledge Resource Management and Cross-Functional Integration

Consequently, this discussion on knowledge absorption leads to the second important category. The company might need to align the internal capabilities of different functions to ensure an effective exploitation of the externally acquired knowledge. In the literature, cross-functional integration has been identified as an essential aspect in this regard (Atuahene-Gima, 2005). Overall, the internal integration success appears very dependent on an effective knowledge resource management process at the organizational level (Chen & Huang, 2009; Cuijpers, Guenter, & Hussinger, 2011). Effective internal knowledge sharing requires management policies be developed to enhance cross-functional integration (Song, Kawakami, & Stringfellow, 2010). Organizations must establish the adequate governance structure that fits to the strategic intent (Vrande, Lemmens, & Vanhaverbeke, 2006), the specific developmental or technological life cycle stage(s) (Cuijpers et al., 2011), the environmental context (e.g. competitiveness, technological dynamism, uncertainty) (Cantarello et al., 2011; Chen et al., 2011), as well as to the prior experiences of the partners (Slowinski et al., 2009).

Cross-functional integration has been associated with successful technology commercialization (Iansiti, 1995; Zahra & Nielsen, 2002). Critical is the ability to overcome internal political turf wars. The not-invented-here syndrome is an indicator of noticeable in-house resistance to the sourcing and utilization of external knowledge, which has been described as a knowledge assimilation barrier (Bierly et al., 2009). Hence, the company needs to avoid this internal inhibitor of effective innovation sourcing. Researchers have noted additional substantial risks related to internal knowledge integration (Marsh & Stock, 2006). Poor internal cooperation can lead to project delays and even termination (Cuijpers et al., 2011). Hence, Cuijpers et al. (2011) recommend that organizations provide sufficient resources (financial and non-financial) for coordination efforts to enable effective innovation sharing. This is another indication that organizations carefully assess the internal environment and context when pursuing innovation sourcing activities. To sum up this section, innovation sourcing will be successful when emphasizing effective internal knowledge integration. This leads to the next research proposition:

Proposition P_2: Internal knowledge integration is positively associated with the level of innovation sourcing.

Innovation Orientation

A broad variety of constructs and cognitive aspects in terms of mindset, attitude, or inclination to support the organizational innovation activities have been mentioned in the literature. Two of which are particularly adequate for this context. Innovation orientation is the inclination to encourage and support internal creative processes and experimentation, intended to lead to new

products or services becoming introduced to the market (Lumpkin & Dess, 1996; Rosenbusch, Rauch, & Bausch, 2013). The construct refers to an organizational "strategy of developing and introducing innovative new products or services into the market before their competitors" (Knudsen and Mortensen, 2011, p. 56). Moreover, innovation orientation can be understood as the inclination to actively seek, acquire, and exploit beneficial new ideas from external constituents to bolster internal innovation processes. The construct refers to an organizational mindset embracing innovation. Innovation orientation has an emphasis on the strategic internal innovation process, while also capturing the consideration of externally available knowledge to support the innovation processes. Two main aspects of innovation orientation relate to an organizational openness toward innovation sourcing and a shared understanding valuing external knowledge (Marsh & Stock, 2006).

Openness Toward Innovation Sourcing

Research has identified organizational culture as influencing the effectiveness of innovation sourcing (De Brentani & Kleinschmidt, 2004). The analysis revealed the need for an organizational mindset emphasizing innovation and open to applying a knowledge based sourcing strategy (Knudsen & Mortensen, 2011). The latter, openness, poses as a central theme of innovation orientation. The organizational tendency to seek, acquire and exploit beneficial externally available knowledge is a main aspect of innovation orientation. One example is an organizational attentiveness to new ideas from the supply base and a commitment for continuous collaborative innovation (Slowinski et al., 2009). Successful organizations are systematically assessing externally available know-how and create a climate that is receptive to external ideas (Cassiman & Veugelers, 2006; Katz & Gartner, 1988). This requires an innovation-focused

decision-making process supporting innovation sourcing and an organizational openness towards externally-available knowledge (Azadegan & Dooley, 2010; Chen et al., 2011; Naranjo-Valencia, Jiménez-Jiménez, & Sanz-Valle, 2011).

Shared Understanding About External Knowledge Value

The necessity to achieve a shared understanding of the innovative value of external ideas has been identified as a complex yet critical aspect of innovation sourcing (Marsh & Stock, 2006). Essential characteristics are a cognitive mindset and a general culture of embracing the use of external knowledge (Azadegan & Dooley, 2010; Chen et al., 2011; Naranjo-Valencia et al., 2011). This serves as a necessary basis for collective actions and decision-making. To achieve this common interpretation of external knowledge, a common thought world about the meaningfulness of innovation is helpful, which illustrates the second main perspective of innovation orientation. Organizations with high innovation orientation recognize the criticality of external knowledge inflow to remain competitive in the long run. Based on the literature review, the innovation orientation concept emphasizes organizational attentiveness especially in regards to externally available knowledge. Nonetheless, it does not only involve technical/engineering but organizational and administrative process knowledge (Naranjo-Valencia et al., 2011). In summary, innovation sourcing requires a organization-wide commitment (Chen et al., 2011). Therefore, innovation orientation is the third dimension of innovation sourcing, and the following is proposed:

Proposition P_3: Innovation orientation is positively associated with the level of innovation sourcing.

Based on the systematic literature review and article analysis, the main dimensions of innovation sourcing are external knowledge integration, internal knowledge integration, and innovation orientation. All three relate to numerous operational and managerial practices in the company. These are depicted in Table 3 along with key contextual factors.

Innovation Sourcing and its Performance Implications

When organizations develop effective mechanisms for conducting innovation sourcing, they will be more innovative and successful in the marketplace (Chen et al., 2011). All three dimensions of innovation sourcing are positively associated with innovation performance. External relationships with suppliers matter, which includes developing the appropriate level of breadth (diversity of external relationships) and depth (relational intensity) (Laursen & Salter, 2006). Effective searching and scouting processes as well as knowledge exchange coordination are relevant for high innovativeness (Kang & Kang, 2009; Oke & Kach, 2012). Research has emphasized the importance of knowledge integration practices of externally acquired knowledge to influence innovation success (Cassiman & Veugelers, 2006). Organizations facilitate the external and internal knowledge exchange to initiate joint learning and increase innovation performance (Chen et al., 2009). This necessitates effective organizational learning processes to assimilate the new ideas (Kang & Kang, 2014; Knudsen & Mortensen, 2011; Wang, Chen, Wang, Lutao, & Vanhaverbeke, 2014). Moreover, researchers underscore the importance of firm-level knowledge resource management within the company (Cuijpers et al., 2011). Enhancing cross-functional integration will lead to successful innovation outcomes (Evanschitzky, Eisend, Calantone, & Jiang, 2012).

Table 3
Main Innovation Sourcing Practices and Processes

Category	External Knowledge Integration			Internal Knowledge Integration		Innovation Culture
Literature	*Laursen & Salter (2006); Leiponen & Helfat (2010); Chen et al. (2011); Oke & Kach (2012); Jiang et al. (2013)*	*Almeida & Phene (2004); Cassiman and Veugelers (2006); Abecassis-Moedas & Mahmoud-Jouini (2008); Gallego et al. (2013); Sabidussi et al. (2014)*	*Almeida & Phene (2004); Marsh & Stock (2006); Kang & Kang (2009); Azadegan and Dooley (2010); Chen et al. (2011); Oke & Kach (2012); Revilla & Villena (2012); Jiang et al. (2013)*	*Cassiman & Veugelers (2006); Marsh & Stock (2006); Kang & Kang (2009); Knudsen & Mortensen (2011); Sabidussi et al. (2014)*	*Roper et al. (2008); Cuijpers et al. (2011); Knudsen & Mortensen (2011); Wang et al. (2014)*	*Laursen & Salter (2006); Marsh & Stock (2006); Azadegan & Dooley (2010); Chen et al. (2011); Knudsen & Mortensen (2011); Naranjo-Valencia et al. (2011); Wang et al. (2014)*
Innovation Sourcing Practices and Processes	Searching, Scouting, and Scanning	External Collaboration; Knowledge Exchange	Interactive Learning	Knowledge Absorption	Knowledge Resource Management; Cross-Functional Integration	Innovation-Focused Decision-Making; Openness for Innovation Sourcing; Open Innovation Culture
Context	Market and Technological Dynamism (Innovation Intensity); Industry; Innovation Type & Scope; Firm Size & Age; Developmental Maturity; R&D Expenditures			Firm Size & Age; Market and Technological Dynamism; Technological/ Development Life Cycle; R&D Expenditures		Firm Size & Age; Innovation Type

The level of innovation orientation influences organizational performance as well. In particular, an effective organizational climate geared towards innovation strengthens new product development performance (Evanschitzky et al., 2012). This can be related to innovation orientation as an attitudinal aspect of the company that emphasizes the appreciation for external knowledge inflow. To improve innovation, an innovation-focused mindset of the company has been described as a critical success factor (Chen et al., 2011; Knudsen & Mortensen, 2011). Innovation orientation appears to be a positive contributor to organizational innovation (Chen et al., 2011). To sum up this section, multiple scholars have noted the positive impact of innovation sourcing on innovation performance (Cassiman & Veugelers, 2006; Perez-Luno, Gopalakrishnan, & Cabrera, 2014). Thereby, innovation sourcing supports the organizational innovation process and can ultimately enhance organizational performance. As researchers have identified a positive correlation between innovation sourcing and innovation performance, the following is proposed:

Proposition P_4: Innovation sourcing is positively associated with innovation performance.

An Agenda for Future Research

The extant innovation sourcing literature was synthesized to develop a conceptualization of this phenomenon. The analysis established the main conceptual dimensions and the relationship with innovation performance, addressing the first two research questions. This section with Stage Five will concentrate on the third question on how to move this research forward. The currently

fragmented research stream has resulted in noticeable gaps, and a focused research agenda will assist in bridging some of those gaps.

An apparent immediate next research step would be to empirically validate the conceptual model derived from the literature review. The testing in multiple environments could confirm the proposed performance implications of innovation sourcing. Further studies could assess and validate the moderating influence of environmental factors mentioned in the literature. Other attention could be placed on the identification of relevant mediating factors. A cross-sectional survey appears as an appropriate methodology to enhance the body of knowledge in this regard. If feasible, longitudinal studies could provide a robustness check and thereby strengthen the conceptual understanding, when the relationships hold over time. To conduct rigorous testing would require further scale refinement and development of the innovation sourcing measurement scale. As described in the prior section, the current scale proliferation concerning innovation performance would also need to be addressed. Apart from a cross-sectional survey, depending on data availability, a secondary data study would also appear as a suitable methodology to address those research questions. However, such empirical validation is highly relevant but appears to cover only the near-term research horizon.

Within a more long-term oriented agenda, exploring the breadth and depth of the phenomenon offers multiple additional research opportunities. Future research should distinguish between macro- (strategic) and micro- (operational) level facets when attending to current research gaps concerning innovation sourcing. Based on the systematic literature review and the highlighted knowledge gaps, four facets of the innovation sourcing phenomenon are particularly recommended for future investigation within a proposed research agenda:

(1) What are the strategic implications of the emergent innovation sourcing phenomenon?

(2) What are operational implications of innovation sourcing?

(3) How could organizations establish a culture of innovation-focus to support innovation sourcing?

(4) How could innovation sourcing enhance the absorptive capacity of an organization?

What are the strategic implications of the emergent innovation sourcing phenomenon?

On a strategic level, the emergence of innovation sourcing requires a fine-tuning of the well-known 'Make or Buy' decision-making process. Organizations have shifted more and more knowledge generation activities from make to buy (Quinn, 2000; Slowinski et al., 2009). As the buy decision becomes more important in regards to innovation, the innovation sourcing process might become more strategically relevant for the company. However, research has not kept pace with practice so that essential questions have remains unanswered. Critical questions for future research include: How does innovation sourcing relate to corporate and/or functional strategies? What is the appropriate level of innovation sourcing for a company in a given environment? How does innovation sourcing influence innovation and financial performance? Is there a curvilinear effect that exists between innovation sourcing and organizational performance, and what does it entail? What are the implications of "too much" innovation sourcing for the company?

To address those questions, three main avenues for further research to this topic area are proposed. First, research could assess whether and how innovation sourcing could result in a competitive advantage for the company. For instance, research would analyze what innovation sourcing sub-processes are particularly relevant or impactful, and under what contingencies.

Second, research could study the implication of organizational alignment or misalignment in regards to innovation sourcing practices. This would involve both vertical alignment (e.g., purchasing to corporate strategy) and horizontal alignment (e.g., R&D strategy to purchasing strategy). Third, future research could investigate whether the strategic role of the purchasing function is affected by the innovation sourcing phenomenon, and explore such implications.

Innovation Sourcing as a Competitive Advantage

Organizations need to determine a long-term strategy for growth (both corporate and business unit level) in accordance to specific market and technological environments (Kang & Kang, 2009). Next, the necessary assets (capabilities) to support this strategy can be defined, and potential gaps to existing competencies identified. At this point, developing an integrated procurement strategy (congruent to corporate strategy) might assist in recognizing which capabilities should be developed internally and which should be externally sourced (make or buy).

Future research could explore the foundation for innovation sourcing decisions. How are the company's core capabilities and strategic resource needs defined? In regard to competitiveness, how are the critical capabilities protected (sustaining a competitive advantage) when engaging in collaboration with external partners? To close potential knowledge gaps, individual innovation sourcing sub-processes might be analyzed in detail. Future research could investigate whether and how innovation sourcing can support the company's strategic adaptation to environmental changes. Finally, a key question concerns the innovation and financial effect of innovation sourcing. Researchers could investigate in more depth whether innovation sourcing results in better organizational performance and whether this would lead to a competitive

advantage in the market place. Different methodologies appear applicable to address this. Qualitative interviews and non-participant observations of managerial meetings could reveal the extent of existing innovation sourcing competence and its perceived strategic relevance in different market environments. Archival data could be used as a separate source to gain financial performance data and relate it to innovation sourcing sub-processes.

Organizational Alignment

The innovation sourcing strategy needs to be adapted to the specific organizational constraints. Achieving fit relates to both vertical and horizontal alignment. First, alignment of the innovation sourcing to the overarching purchasing and, ultimately, corporate strategy is critical. Practitioners need guidance in this regard. The purchasing strategy should direct innovation sourcing decisions. The former will be based on the given tradeoffs between various innovation and purchasing performance dimensions and the corporate objectives (Fisher, 1997). Researchers could compare the consequences of coordinated versus uncoordinated, contradictory activities in regards to innovation sourcing (Chesbrough, 2006). Naturally, an innovation sourcing strategy emphasizing high end, high technology component sourcing might contradict an overarching cost leadership corporate strategy.

Second, scholars could investigate the horizontal alignment of functional strategies. Organizations need to manage the innovation sourcing process carefully, avoiding the 'over-search' phenomenon and spreading the scarce internal resources too thin (Laursen & Salter, 2006). To reach the sweet spot, innovation sourcing needs to be executed in a balanced way, considering intra-organizational capabilities and constraints as well as learning opportunities (Marsh & Stock, 2006). This might significantly differ from function to function. In this way,

research could contrast the impact of different functions, particularly the purchasing and internal R&D departments. The purchasing function is typically the contract holder and manages the commercial relationships with external partners. To avoid commercial pitfalls, purchasing and engineering should work together closely and enhance their internal cooperation in practice. Calls for researchers to investigate processes at the intersection between engineering and purchasing (Brattström & Richtnér, 2014) could be addressed.

Researchers have investigated some aspects of cross-functional collaboration between purchasing and other functions such as engineering (Cuijpers et al., 2011). But in light of the emergence of innovation sourcing, further research appears warranted to explore further the consequences and trade-offs of cross-functional integration and horizontal alignment. To empirically assess the level of alignment, perceptional measures would need to be used. Hence, a cross-sectional survey could be applied to verify the influence of strategic alignment of innovation sourcing on innovation and financial performance of the company. Alternatively, the analysis of secondary data (e.g., publicly available reports about procurement and corporate strategies, along with innovation activities) could be a suitable methodology to approach relevant research questions in this area.

The Strategic Role of Purchasing

The trend towards innovation sourcing might affect purchasing's strategic role within the company. Hence, an important avenue for research concerns purchasing's objectives in this regard. Potential research questions for future studies include: What is the strategic impact of purchasing on the organization's innovation performance? What is purchasing's role in facilitating innovation sourcing? Within the emerging trend toward innovation sourcing, does

purchasing enhance its strategic relevance and clout within the company? A specific aspect would concern the facilitator role concerning innovation sourcing. As such, who is critically supporting or nurturing innovation sourcing within the company? Who is the most appropriate driver of innovation sourcing within the company? What are performance differences when innovation is driven top-down from (upper-echelon) management in contrast to being driven from the purchasing function? Should purchasing simply support the innovation sourcing processes under the guidance of engineering? Or should it take a more active role (driver's seat position)? What is the performance impact when purchasing is driving innovation sourcing? How does this influence the other purchasing processes?

This literature review confirms that more research interest in the role of purchasing is justified. One strategic opportunity for the purchasing function could emerge in terms of managing and shaping this process by taking an active role within the company as the innovation sourcing driver. Research could analyze purchasing's position in different contexts with varying levels of innovation sourcing. Questions include whether and how the integration of external knowledge is establishing a new core competency in the company, and how this relates to purchasing. This type of research might provide a new perspective on a number of theoretical frameworks such as knowledge based view, resource based theory, resource-dependency theory, transaction cost economics, or organizational learning, for instance.

Moreover, practical implications would arise from such research as well. As innovation sourcing practices are emerging as a growing trend, a new role of purchasing in strategically managing this process might appear fruitful for some organizations. Researchers could investigate such circumstances and provide relevant advice on contingencies to practitioners. Qualitative research methodologies such as ethnography or phenomenology could be suitable to

enhance the detailed understanding of purchasing's role in innovation sourcing, and to develop the theoretical foundation. Case studies could lead to additional insights through cross-case analysis in different contexts.

What are operational implications of innovation sourcing?

Innovation sourcing is affecting the company at an operational level. Ultimately, innovation implies a constantly evolving product, service, and process portfolio. For innovation sourcing to emerge as a core competency, organizations need to develop innovation sourcing practices (Marsh & Stock, 2006). Hence, researchers are encouraged to deep dive into the operational details of the innovation sourcing process to provide guidance about the necessary innovation sourcing routines that lead to better innovation performance. The detailed innovation sourcing mechanism on an operational level has not received sufficient scholarly attention. Researchers have already identified a lack of procedures as an inhibitor of the effective knowledge inflow, and eventually of innovation performance (Almeida & Phene, 2004). For example, effective and efficient innovation sourcing practices might impact organizational performance differently, depending on each organizational function. Potential future research questions include: What specific operational sub-processes from different functions enhance innovation performance, and how? What routines or practices facilitate innovation sourcing performance, and what aspects inhibit it? How should those functional routines be developed and implemented? What are the operational implications in detail? How are operational purchasing processes affected?

To address those questions, three main avenues for further research are proposed. First, research could assess whether and how innovation sourcing shows a functional operational impact, and how this relates to organizational performance. For instance, research could

investigate the influence of operational routines of different functions on innovation performance, and vice versa. Second, scholars could focus on knowledge integration practices and its performance consequences. Third, the potentially moderating influence of environmental and demographic factors on the relationship between innovation sourcing and innovation performance could be analyzed.

Functional Impact of and on Innovation Sourcing

A promising roadmap for future research could include a multi-functional approach when studying operational implications related to innovation sourcing. What are the implications for different functions within the company? For instance, the phenomenon intersects a number of fields such as supply management or innovation management. How could the body of knowledge of both the supply chain management and the innovation literature be enhanced when studying the innovation sourcing phenomena at an operational level, comparing different functional perspectives? Many empirical studies of this literature review have noted that without enhancing innovation sourcing practices, the organizational innovation performance will remain limited.

Researchers need to better understand the relevant workflows, procedures, and work routines on the micro level, and how the end-to-end business processes are affected. Innovation sourcing practices step outside of the traditional functional boundaries, impacting marketing, logistics, manufacturing, or engineering workflows. Interesting and relevant research studies could focus on the interplay between knowledge flow and organizational learning when comparing different organizational functions (Marsh & Stock, 2006). The performance impact of different knowledge flow collaboration practices might also vary within the company. Hence, to

enhance the understanding of the functional impact, scholars should strive to build cross-disciplinary bridges and illuminate the phenomenon from varying functional viewpoints.

Knowledge Integration Practices

Remaining theoretical gaps inspire future research. For example, micro-level theories about external and internal knowledge integration need to be developed and tested. Researchers could contrast different organizational routines in terms of innovation performance (Leiponen & Helfat, 2010). Scholars might scrutinize knowledge integration and absorption practices and verify their effectiveness and efficiency. What are the best knowledge management routines to enhance innovativeness? How does management determine and measure a desired degree of knowledge integration efforts? Researchers could provide new insights when exploring the role of senior and middle management in this regard.

Interesting would be to analyze the causal effects between innovation sourcing and innovation performance. Primarily, it is proposed that the former drives the latter. However, scholars could investigate whether in practice, organizations determine a desired level of innovativeness first before developing the corresponding operational innovation sourcing practices. Overall, researchers would need to shift attention toward a systematic, holistic approach on innovation sourcing. Insights from related scholarly fields (marketing, engineering, or strategic management, for example) could enhance the purchasing and supply management literature. Inductive research methodologies could be applied to reveal the necessary depth and richness of the innovation sourcing sub-processes, including workflows and routines. When developing a conceptual framework in detail, scholars could establish a foundation for theory development in this field.

Environmental Influence on Innovation Sourcing and Innovation Performance

Innovation decisions are highly context-dependent, so that generalizations require adequate caution. Future research should increase the understanding of those environmental and demographic factors that potentially alter the innovation sourcing decision-making, and influence the performance outcomes (Cassiman & Veugelers, 2006). A number of important research questions arise: How robust is the innovation sourcing to performance relationship under varying environmental conditions? What are critical contingencies in regards to the innovation sourcing mechanism? What are the most essential environmental factors that moderate the performance impact, and what factors determine boundary conditions? What contextual factors (e.g., market and technological environment; developmental life cycle; innovation type) are influencing (and how) the most appropriate governance structure? A cross-sectional survey methodology could be applied to test the environmental impact on innovation performance. Alternatively, researchers could prepare an experimental design study to investigate the performance implications when manipulating various environmental and demographic factors.

How could organizations establish a culture of innovation-focus to support innovation sourcing?

Researchers have particularly emphasized the need for external collaboration to achieve an effective innovation sourcing process (Almeida & Phene, 2004; Azadegan & Dooley, 2010). Nonetheless, the degree of shared values and beliefs in terms of joint innovation also influences new product performance (Wagner, 2010). For example, internal collaboration is critical to enhance the organization-specific innovation processes and routines (Cuijpers et al., 2011), which might require a shared innovation-focused mindset across the company. Attitudinal

aspects might influence innovation performance and innovation sourcing (De Brentani & Kleinschmidt, 2004). Research could study how those cultural aspects influence innovation, and ultimately, financial performance. How could management initiate and nurture a cultural change towards innovation? How important is culture to the innovation sourcing process? Researchers have highlighted that innovation sourcing will only be successful with a sufficient level of top management commitment, and might even necessitate the adaptation of organizational culture towards innovativeness (Slowinski et al., 2009). But what cultural changes influence the level of innovation sourcing? Those aspects could benefit from further scholarly investigation. Analyzing the role of operational, middle, and senior management in enhancing the innovation sourcing process could be the focus of a future research stream.

Another interesting aspect would be to compare and contrast attitudes on an individual versus organizational level. In particular, the impact of those aspects on the fuzzy-front end phase of innovation projects, or the ideation, idea generating stages, could be a fruitful research opportunity, as this phase is particularly dependent on creativity and fresh ideas (McNally, Akdeniz, & Calantone, 2011). One potential approach would be to develop a conceptual model based on a literature review, and then subsequently test the model with a cross-sectional survey methodology. Alternatively, future research could be based on an experimental design methodology to investigate the interplay between cultural (attitudinal) and structural (governance) factors, and its corresponding performance implications.

How could innovation sourcing enhance the absorptive capacity of an organization?

This study of the innovation sourcing phenomenon revealed the necessity for more scholarly attention to the firm-level concept of absorptive capacity (Abecassis-Moedas & Mahmoud-

Jouini, 2008). Scholars have confirmed that absorptive capacity influences the organization's innovation performance (Cohen & Levinthal, 1990). Existing research has focused primarily on R&D and engineering processes to assess the dimensions and impact of this concept (Cassiman & Veugelers, 2006). However, other scholars have highlighted that further indicators apart from R&D activities could be relevant to understand additional perspectives of the absorptive capacity concept (Clausen, 2013) and called for more research in this regard (Kang & Kang, 2009). How would innovation sourcing relate to absorptive capacity? Conceivably, in addition to R&D, the aspects of education, training, learning, and recruiting processes are all influencing the level of absorptive capacity? Furthermore, it could be fruitful to investigate the key innovation sourcing routines supporting knowledge acquisition and knowledge integration processes. To refine the absorptive capacity concept, a better understanding of the role of innovation sourcing processes appears necessary, especially in regards to potential interaction effects with R&D practices. Possibly, the integration drivers and attitudinal aspects revealed in this systematic literature review are components to enhance the organization's absorptive capacity and, ultimately, innovation and financial performance.

To guide further research, one proposed research avenue would be the exploration of potential additional dimensions of absorptive capacity. A number of research questions could be explored: Does absorptive capacity entail non-engineering or non-R&D aspects (if yes, what are they)? How relevant are purchasing or sourcing processes in general, or particularly innovation sourcing processes for the level of absorptive capacity? Could innovation sourcing be considered a dimension of absorptive capacity? If yes, what would be the interplay between innovation sourcing and R&D processes and the corresponding effects on organizational performance? What are the performance consequences of varying degrees of R&D and innovation sourcing

capability in this regard? To study the phenomenon of absorptive capacity, an exploratory case study could reveal the richness and breadth of possible non-engineering-related practices or processes that impact the absorptive capability of the organization. A fruitful follow-up study could then empirically test the new conceptualization derived from the prior exploratory research. The theoretical contribution would include a refined understanding of the multidimensionality of absorptive capacity, the role or influence of innovation sourcing, and the impact on innovation and financial performance.

Implications and Conclusion

This systematic literature review enables a better understanding of the phenomenon of innovation sourcing. Nonetheless, fruitful research opportunities remain. The research has provided an agenda to initiate a subsequent research stream, which should make this exciting and relevant area of research more mainstream. There are still some implications for theory to discuss.

Theoretical Contributions

This research study provides several theoretical contributions. First, the innovation literature is extended to include the concept of innovation sourcing with a particular focus on the upstream supply chain perspective. The systematic review of an important supply chain concept along with a conceptual development of the main dimensions of innovation sourcing is a theoretical contribution. The conceptualization enhances the theoretical breadth and depth of the open

innovation theoretical framework by detailing the complementary innovation sourcing perspective from the upstream supply chain.

Second, the innovation sourcing mechanism is more thoroughly explained. The key concepts of this phenomenon have been clarified and definitions of essential terms have been provided. The three main dimensions of innovation sourcing have been developed based on a broad set of empirical literature. The study provides a foundation for further analysis on the interaction of sub-processes and the corresponding influence on organizational performance. Specifically, the new framework can assist with identifying challenges in the innovation sourcing process and thereby support the innovation failure analysis. Consequently, enhancing the conceptual understanding of the innovation sourcing phenomenon is not solely theoretically interesting and important but also highly relevant for practitioners.

Third, the fragmented literature stream on innovation sourcing is synthesized and research gaps are noted. By providing an agenda for future research, those gaps can be addressed in subsequent investigations. As innovation sourcing relates particularly to procurement processes, for instance, a need for further research regarding the role of purchasing has been explained.

Fourth, this research has linked the research of supply chain management with innovation management research. A main contribution of this dissertation research is connecting the disparate literature streams (e.g., supply management, marketing, and strategic management body of knowledge) to create an overview of relevant definitions and operationalizations of innovation performance in the context of product/service innovation. Therefore, a multi-disciplinary body of knowledge has been assessed and synthesized to address the research questions.

Fifth, the systematic literature review has revealed a strong emphasis on external integration and exploitation in current scholarly work on innovation sourcing. Some researchers have already progressed toward linking external with internal knowledge integration, which have been identified as complementary aspects (Cassiman & Veugelers, 2006). To obtain a more comprehensive understanding of this complex phenomenon, all three dimensions will need to be addressed holistically and (possibly) concurrently in future research.

Finally, this study highlighted the opportunity for further theoretical development and extension of the absorptive capacity concept. In addition to R&D-related activities, other aspects such as education, training, learning, and recruiting processes could be investigated. They all might influence the level of absorptive capacity on an organizational level. Beneficial would be an understanding in regards to the role of purchasing processes and how they might complement engineering and R&D practices to enhance a company's absorptive capacity. Thereby, future research could respond to calls to analyze the purchasing perspective on open innovation processes (Gassmann et al., 2010).

In conclusion, several important theoretical contributions of this study have been provided. The systematic literature review has identified a lack of coherence in the body of knowledge on innovation sourcing. Following the proposed agenda, future research could narrow the current gap. Yielding interesting and insightful new perspectives on the innovation sourcing phenomenon is expected.

Implications for Practice

The practical implications are as follows. This research illustrates potential improvement areas that managers can focus on to enhance the innovation performance of their company. Innovation

sourcing requires not only the effective integration of knowledge input from external partners, but also an effective internal cross-functional integration structure facilitating the joint development activities. The research is providing guidance about the critical dimensions of innovation sourcing. Managers need to consider the interplay between external and internal knowledge integration along with innovation orientation as a cultural element. Thereby, they could enhance the innovation success rate and avoid costly innovation failures.

This dissertation research explains the need for cross-functional alignment along with coordinated internal and external knowledge integration practices. In addition, the fundamental need to encourage and foster an innovation-focused mindset within the company is highlighted. Overall, the research has illustrated the necessity for managers to combine all three dimensions to achieve higher innovation performance. The combined efforts of developing external relationships, encouraging cross-functional integration, and fostering innovation orientation will become increasingly a decisive success factor. Managers need to develop an integrative (holistic) approach towards innovation sourcing that is aligned with corporate strategy as well as with the suppliers' innovation strategies. Thereby, the company will be able to orchestrate an innovative (sourcing) network and achieve a sustainable competitive advantage.

As outlined in the research agenda, the phenomenon stretches beyond the traditional purchasing domain and extends to both the strategic management and the operational level involving cross-functional practices and work routines. Hence, in the following chapter, the research focus is broadened. The next study concentrates on the more encompassing supply chain resource management practices, involving specifically the acquisition and integration of external resources. A theoretical framework of supply chain resource orchestration is introduced.

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Appendix

Appendix 1 - Exclusion and Inclusion Decisions

The following systematic inclusion and exclusion decisions were taken during the article screening process (Newbert, 2007):

Exclusion and Inclusion Decisions

- Include papers published in peer-reviewed academic journals in English language
- Limit papers to the 2000-2015 time frame
- Limit papers to research papers and exclude editorials, book reviews; commentaries, special issue introductions, and similar non-relevant papers
- Exclude all papers that do not have at least one corresponding keyword hit in either title or abstract or keyword list
- Exclude all papers, after reading the abstract, that are not relevant to the research questions (include only papers with a clear research focus (orientation) related to the research topic) (refer to Appendix 2)
- Exclude conceptual papers and literature reviews (step 4)

Appendix 2 - Exclusion and Inclusion Decisions (Detailed Content Evaluation)

Exclusion Criteria (*)

- Focus on financial ownership perspective (e.g., M&A of technology organizations)
- Focus on customers only / pure user involvement
- Crowdsourcing with pure user-input
- Pure Software development (open source)
- Focus on macroeconomic aspects (e.g., specific nations, or inter-country aspects)
- Focus on intellectual property aspects (legal or financial revenue, patent revenue emphasis)

Inclusion Criteria (*)

- Involvement of external entities (e.g., suppliers, universities, private (research) institutions, governmental institutions) for joint innovation
- All aspects of procurement and sourcing of technology, incl. sourcing strategy development
- Research focusing on resource (asset) and capability development based on external input or joint innovation activities
- Structure and governmental mechanisms of co-development (joint innovation)
- Cultural and social capital aspects of joint innovation
- Development and use of knowledge exchange mechanisms for co-development (joint innovation)

(*) *Criteria utilized for exclusion and inclusion decision-making during the initial screening phase (title, key word, and abstract screening)*

Appendix 3 - Operationalization of Innovation Performance

Operationalization of Innovation Performance and Related Constructs	Type	Source
Innovation Success (new product performance): (1) Relative to other products of our firm, this one has a better return on investment (2) Relative to our competitors' products, this one has a better return on investment (3) This new product has succeeded in achieving its main objectives	F, PS	Gatignon and Xuereb (1997)
Incremental Innovation Performance: (1) Percentage of total sales from incremental product introduced by your firm in the last three years (2) This firm frequently introduced incremental new products into new markets in the last three years (3) Compared to your major competitor, this firm introduced more incremental new products in the last three years	M	Atuahene-Gima (2005)
Radical Innovation Performance: (1) Percentage of total sales from radical product introduced by your firm in the last three years (2) Number of radical products introduced by the firm in the last three years (3) Compared to your major competitor, this firm introduced more radical new products in the last three years (4) This firm frequently introduced radical new products into markets totally new to the firm in the last three years	M	
Administrative Innovation Performance: (1) Responsiveness to environmental changes (2) Innovative administration in planning procedures (3) Innovative administration in process control systems (4) Innovative administration in integrated mechanisms	Pr	Chen and Huang (2009)
Technical Innovation Performance: (1) Developing new technologies (2) Incorporating technologies into new products (3) Facilitating new processes to improve quality and cost	Pr, PS	
Product Innovation Performance: (1) Market share relative to the firm's stated objectives (2) Sales relative to stated objectives (3) Return on assets relative to stated objectives (4) Return on investment related to stated objectives (5) Profitability relative to stated objectives	M, F	Luca and Atuahene-Gima (2007)
New Product Performance: Meeting objectives … (1) Relative to your firm's original objectives for this product, this product is very successful in terms of customer satisfaction (2) Relative to your firm's original objectives for this product, this product is very successful in terms of technological advancement (3) Relative to your firm's original objectives for this product, this product is very successful in terms of overall performance	M, PS	Nakata and Im (2010)
Innovation Performance (product, process and organizational innovation): (1) Whether the company can improve its product quality by innovation (2) Whether the company can accelerate the commercialization pace of the new products by innovation (3) Whether the company make considerable profit from its new products (4) Whether the company can develop new technology to improve operation process (5) Whether the company purchase new instruments or equipment to accelerate productivity	PS, Pr, F	Chen et al. (2009)
Innovation Performance: The ratio of the annual sales (for the year 2000) that originated from new or substantially improved products/services introduced over the period 1998–2000 divided by the total annual sales of the company for the same period. Alternative measure as robustness check: A dummy variable that equals 1 if the firm has introduced a product or process innovation over the period 1998–2000 and 0 otherwise.	M	Kostopoulos et al. (2011)
Innovation Performance (use of three proxies): (1) *[Radical Innovation]* The fraction of the firm's turnover relating to products new to the world market (2) *[Incremental Innovation]* The fraction of the firm's turnover pertaining to products new to the firm (3) *[Incremental Innovation]* The fraction of the firm's turnover pertaining to products significantly improved	M	Laursen and Salter (2006)
New Product Development Performance: (1) From an overall profitability standpoint, our new product development program has been successful (2) Compared with our major competitors, our new product development program is far more successful (3) Compared with our major competitors, our new product development cycle time has been shorter (4) Our product lines are much broader than those of our competitors	F, Pr	Song et al. (2010)
New Product Development Performance: (1) New products do not provide a significant source of revenues for the company (reverse coded) (2) Our company develops better products than its competitors (3) Over time, we continually improve our product development processes (4) Our company is more innovative than its competitors (5) Our company consistently meets our technical objective in new product development	M, PS, Pr	Marsh and Stock (2006)
Success Rate: Think about the group of international new product projects that entered development and had significant amounts of money spent on them. Over the last three years ... (1) percent (rough estimate) were launched and are commercial successes? (%)	M	De Brentani and Kleinschmidt (2004)

M = Market Performance (e.g., sales, sales growth, product introductions, customer satisfaction); F = Financial Performance (e.g., profitability, return on investment, return on assets); PS = Product and Service Performance (Characteristics) (e.g., functionality, quality, technology); Pr = Process Performance (e.g., development cycle time, effectiveness of workflows, routines, and practices) (Schmelzle and Tate, forthcoming)

CHAPTER THREE – ARTICLE 2: THEORY ELABORATION

Abstract

Innovation is a strategic necessity in many markets, and external resource providers have become critical contributors to enhanced innovation processes. However, relatively few studies have assessed the new emerging concept of supply chain resource orchestration (SCRO) that describes the relevant processes of managing the acquisition, integration, and exploitation of critical external resources. After the literature review in Chapter 2, now a theory elaboration approach is utilized to broaden the scope of resource orchestration theory (ROT) by addressing supply chain resources as a critical component of organizational success. The overarching purpose is to better understand the meaning and performance implications of SCRO, and how organizational culture influences the SCRO-Performance relationship. Qualitative interviews with supply chain managers complement and enrich this theory elaboration approach. This research extends the resource orchestration framework to supply chain phenomena and the open innovation context. The construct of supply chain resource orchestration is introduced as an essential capability for the firm's competitive position. Directions for future research are proposed and several theoretical and managerial implications are offered as contributions to both practice and the academic research community.

Introduction

In the global business environment characterized as increasingly hyper-competitive (Ireland & Webb, 2009; Rodríguez & Nieto, 2016; Townsend & Calantone, 2014) effective innovation processes are essential to maintain competitiveness. However, companies cannot continuously innovate solely on their own but require the appropriate inflow and integration of critical external resources to support in-house innovation activities (Chesbrough, 2003). The nature of innovation processes is changing, with organizations becoming less reliant on internal processes alone (Gassmann, Enkel, & Chesbrough, 2010; Oke, Prajogo, & Yayaram, 2013). Consequently, firms need to look upstream in their supply chain to attract and maintain suppliers that can offer critical external support to the innovation activities (Allred & Swan, 2014).

Organizations are reaching out for support from external entities to enhance innovation (Leiponen & Helfat, 2010). They involve their supply base, their customers, and additional third-party entities (e.g., research institutions) (Chesbrough, 2003). By innovating jointly with external partners, risks and costs of complex innovation projects are shared, which ultimately results in cost savings, and higher innovation speed or quality (West & Bogers, 2014; Yli-Renko, Autio, & Sapienza, 2001). Innovating cooperatively with external entities is inherently complex (Hu, McNamara, & Piaskowska, 2017). Decision-making processes can become slow and burdensome. Acquiring and integrating relevant tangible and intangible resources (e.g., specific knowledge, solutions, technology, etc.) from the supply chain is a failure-prone process (Bruce, Daly, & Kahn, 2007). However, the reasons for innovation process failure are not well understood yet as resource management practices have had relatively little attention in the literature (Barney, Ketchen, & Wright, 2011).

Important theoretical gaps remain in regard to the phenomenon of managing external resources. Such gaps relate to the four elements of good theory, namely (1) theoretical domain clarification, (2) key construct definitions, (3) relationships among constructs, and (4) the corresponding theoretical predictions (Wacker, 1998). For example, there are gaps related to how external resources lead to a competitive advantage. There is also little known about the details of resource management capabilities including the concrete practices necessary for success. Deeper insights about the relationship between such capabilities and competitive positioning or organizational performance are needed. Further research should provide a better understanding about the origin of resources (internal vs. external) because this aspect might influence the competitiveness of the firm. Finally, the effect of organizational culture on the consequences of resource management decision-making appears under-researched as well. The gaps indicated above lead to several interesting research questions:

RQ1: How can supply chain resource orchestration be conceptualized?

RQ2: What concrete SCRO practices are performed by organizations to manage tangible and intangible resources from external entities for the purpose of enhancing the corporate innovation performance?

RQ3: How does organizational culture affect SCRO outcomes?

This research will address these questions by exploring the concept of supply chain resource orchestration (SCRO) and enhancing the (theoretical and practical) understanding of the meaning of SCRO. This research also investigates how organizational culture might affect SCRO and innovation performance. Specifically, the origin of resources will be considered, adding external

sources of resources to the domain. The intent is to analyze how this broader perspective including internal and external resources might enhance the predictive and explanatory powers of resource management theory. It is intended to initiate a discussion of the conceptualization, domain, boundary conditions, and contextual influences concerning the phenomenon of supply chain resource orchestration.

Following Wacker's (1998) procedures of good theory-building, the current resource management research stream can be broadened to include organizational capabilities related to the orchestration of external resources. In this research, a theory elaboration method (Ketokivi & Choi, 2014) is applied and qualitative data from case studies are used as evidence. The purpose of this theory elaboration research is to explore how the existing resource management theoretical frameworks could be expanded to address the orchestration practices for supply chain resources. Thereby, this research is a response to repeated calls for more theory-building research in the operations and supply chain management field (Carter, 2011; Choi & Wacker, 2011; Dubois & Salmi, 2016). The aim is to make an initial attempt toward an organizational level theory of SCRO as an elaboration of resource orchestration theory (ROT) (Sirmon, Hitt, Ireland, & Gilbert, 2011).

Theoretical Foundation

The phenomenon of supply chain-driven innovation, which encompasses supply chain resource management, has many facets that are rooted in different academic disciplines. Supply management (sourcing), entrepreneurship, strategic management, and marketing literature offer a diverse research foundation for this complex phenomenon. As a starting point for the theory

elaboration process, the resource management theories are analyzed, beginning with the resource-based theory (RBT).

Resource Management Theories

Resource-based theory (RBT) has been applied in the strategic management literature to explain why organizations differ in performance (Crook & Esper, 2014; McIvor, 2009). According to RBT, the organization is "a bundle of valuable strategic resources inside the firm" that can be employed to enhance competitiveness (McIvor, 2009). Managers need to establish an inimitable resource portfolio that enables the firm to gain a competitive advantage leading ultimately to better performance in the market place. Resource acquisition performance differentials have been attributed to information asymmetry in strategic factor markets (Barney, 1986; Ellram, Tate, & Feitzinger, 2013).

RBT has also been utilized to explain and predict innovation performance differences (Ettlie, 1995; Pfeffer & Salancik, 1978). An underlying assumption of the resource-based theory is that the resource characteristics are influencing organizational performance (Ketchen, Wowak, & Craighead, 2014). Specifically, the "tacitness, complexity, and specificity" characteristics of resources can prevent imitation by competitors and thus enable improved market performance (McEvily & Chakravarthy, 2002). Apart from the resource-based theory, further consideration is given to the dynamic capabilities theory (DCT) and resource orchestration theory (ROT), which are extensions of RBT. The theory of dynamic capabilities posits that the timely re-configuration of critical resources enables organizations to adapt to an environment of uncertainty and volatility, which can result in a competitive advantage (Eisenhardt & Martin, 2000; Teece, Pisano, & Shuen, 1997). In dynamic markets, the continuous configuration and manipulation of

knowledge resources have been observed as particularly essential (Eisenhardt & Martin, 2000; Grant, 1996; Kogut & Zander, 1996). Finally, the resource orchestration theory is an emerging theoretical perspective on resource management emphasizing the critical role of managerial actions (Ketchen et al., 2014; Koufteros, Verghese, & Lucianetti, 2014).

ROT has roots in resource-based theory and dynamic capabilities theory (Sirmon et al., 2011). Resource orchestration is concerned with the managerial decisions and processes about how to manage resources effectively and efficiently (Baert, Meuleman, Debruyne, & Wright, 2016). Specifically, ROT concerns structuring the firm's resource portfolio, bundling resources into capabilities, and leveraging the capabilities to create value for customers (Hitt, Ireland, Sirmon, & Trahms, 2011). Resource orchestration theory is broadening the RBT domain by emphasizing the role of managerial activities in realizing the competitive benefits of strategic resources (Sirmon et al., 2011). Even if abundant resources are available, a competitive advantage can only be achieved with effective resource management practices (Ketchen et al., 2014). The possession of resources alone does not guarantee competitiveness for the organization (Baert et al., 2016). In contrast, effective resource administration or orchestration practices enable high organizational performance (Hansen, Perry, & Reese, 2004; Ketchen et al., 2014; Wowak, Craighead, Ketchen, & Hult, 2016).

Resource Management Practices – Theoretical Gaps

Current resource management theory including RBT, DCT, and ROT, has several gaps and appears in need of further development. Little research has focused on the actual practices and micro-processes of integrating external knowledge resources (Sirmon et al., 2011). In particular, the integration of critical resource inflow from the upstream supply chain has not been

sufficiently addressed (Baert et al., 2016). Some researchers have investigated the acquisition of companies and business units (entire legal entities) as macro-level resources (Maritan & Peteraf, 2011; Wang & Zajac, 2007; Wiklund & Shepherd, 2009). However, relatively little is known about the acquisition and integration processes and managerial practices concerning more micro level resources (e.g., specific knowledge or technology to support innovation processes). The lack of understanding particularly refers to organizing resources such as knowledge of structures, routines, processes, and systems (Yli-Renko et al., 2001).

For both practice and academia, the conflict between increasing involvement of external partners in the innovation process (Madhok & Tallman, 1998) and increasing innovation failure rates has not been resolved yet (Castellion & Markham, 2013; Ireland & Webb, 2009; Wowak et al., 2016). To address this conflict, research needs to look beyond the focal organization's resource management and include the practices of managing the external resource inflow within the scope of the investigation. Specifically, organizations differ in their effectiveness of integrating resources, which explains in part heterogeneity among organizational performance (Maritan & Peteraf, 2011). Scholars have called for more research about the micro foundations and sub-processes of resource management, the detailed managerial actions, and their performance impact (Wiklund & Shepherd, 2009).

Neither DCT nor ROT has fully addressed the integration of resources originating from outside of the organization's boundaries. So far, the resource orchestration literature was focused primarily on internal resource management and integration activities (Baert et al., 2016). Deeper theoretical understanding of what managerial practices lead to higher innovation performance is needed. A paucity of research has been noted in terms of organizational routines and capabilities related to resource management (Maritan & Peteraf, 2011). The theoretical domain could be

broadened to consider the impact of cultural factors (e.g., innovation culture) on resource management practices. Scholars called for more research on the impact of mental models and managerial cognition on resource management processes and outcomes (Maritan & Peteraf, 2011). Also, the origin of the resource does not matter in the RBT perspective, where other resource attributes are emphasized (e.g., valuable or rare) (McIvor, 2009). In conclusion, resources play a role in achieving a competitive advantage and enhancing performance (Crook, Combs, & Todd, 2008). DCT and ROT emphasize the mediating effect of, respectively, resource configurations and resource orchestration practices.

Core Components of Resource Management Theory (RBT, DCT, ROT)

Following the Wacker (1998) approach to theory development, the applicable resource management theoretical frameworks are analyzed. Specifically, the constructs, domain, theoretical relationships, and the predictions (factual claims) are assessed. A summary is provided in Table 4 with further discussion following.

The research follows the guidelines for good theory-building (Wacker, 1998), which has served as a foundation for theory development in the operations and supply chain management field. Wacker (1998) provides an effective structure for analyzing theoretical gaps, and has been applied in prior theory elaboration research (e.g., Tate and Bals, 2016). Wacker maintains that 'good' theory development should follow similar research procedures, which would enable theory to "become integrative" and permit to raise the abstraction level of theory (Wacker, 1998, p. 379). RBT, DCT, and ROT, which are relevant theoretical frameworks in this context, are compared first by analyzing the four main components of good theory. As depicted in Table 4, those three theories have the prediction between resources and performance in common.

Table 4
Constructs, Domain, Relationship, and Predictions of RBT, DCT, and ROT

Theory Aspect	RBT	DCT	ROT
Constructs	• (Strategic) Resources • Capabilities/ Competencies • (Sustainable) Competitive Advantage • Organizational Performance	• (Strategic) Resources • Resource Configuration Practices • Capabilities • (Temporary) Competitive Advantage • Organizational Performance	• (Strategic) Resources • Capabilities (Managerial Practices) • (Temporary) Competitive Advantage • Organizational Performance
Domain	• Competitive Market • Value Creation Objective	• Dynamic Market Environment • Focal Organization • Uncertainty • Value Creation Objective	• Competitive Market • Focal Organization • Value Creation Objective • Contingent on life cycle phase, strategic breadth, and organizational level (depth)
Relationships & Predictions	Resources → Competitive Advantage → Performance	Resources → Resource Configurations → Competitive Advantage → Performance	Resources → Resource Orchestration → Competitive Advantage → Performance

Key Construct Definitions of RBT, DCT, and ROT

Fundamental to good theory are clear theoretical definitions of relevant constructs applied in the theory (Wacker, 1998). Resources are described as tangible and intangible assets utilized for strategy implementation (Barney & Arikan, 2001; Kozlenkova, Samaha, & Palmatier, 2014). Specifically, essential strategic resources are defined as enduring productive capabilities and includes intangibles such as customer relationships, image, R&D alliances, know-how, etc. (Ettlie, 1995).

Resource based theory suggests that the management of an organization's resources is a critical competitive enabler. According to RBT, organizations are understood as resource bundles. The resource distribution among organizations is assumed as heterogeneous, and the resource differentials (variances) are assumed as sustainable over time (Amit & Schoemaker, 1993; Mahoney & Pandian, 1992; Wernerfelt, 1984). A sustainable competitive advantage is achievable when organizations possess and apply *valuable, rare, inimitable and non-substitutable* resources (VRIN attributes) (Barney, 1991) and thereby implement novel value-creating strategies difficult to duplicate by the competition (Conner & Prahalad, 1996; Eisenhardt & Martin, 2000; Wernerfelt, 1984).

Those strategic resources include "all assets, capabilities, organizational processes, firm attributes, information, knowledge, etc. controlled by a firm that enable the firm to conceive of and implement strategies that improve its efficiency and effectiveness" (Barney, 1991). An organization's resources should not only be valuable, rare, and inimitable to enable a competitive advantage; additionally, the company also must establish an appropriate *organization* (VRIO attributes) to strategically exploit these resources effectively and efficiently (Kozlenkova et al., 2014).

Valuable resources can lead to reduced net costs and/or higher revenues (Barney & Arikan, 2001). While rare resources are "controlled by a small number of competing firms," inimitable resources are costly to acquire or create for competitors (Kozlenkova et al., 2014, p. 4). Within the dynamic capabilities theory (Eisenhardt & Martin, 2000; Teece, 2007), dynamic capabilities are strategic processes aiming at the identification, integration, and re-configuration of critical resources in a dynamic environment (Teece et al., 1997). Effective resource orchestration practices could be conceptualized as a dynamic capability. As such, ROT provides more emphasis on the details of the core capability of resource orchestration with its sub-processes of structuring, bundling, and leveraging.

Resource Orchestration Practices

Resource orchestration refers to "actions to structure the firm's resource portfolio, bundle resources into capabilities, and leverage the capabilities to create value for customers, thereby achieving a competitive advantage for the firm" (Hitt et al., 2011, p. 64). More specifically, (1) structuring includes acquiring, accumulating, and divesting resources; (2) bundling involves stabilizing existing capabilities, enriching current capabilities, and pioneering new capabilities. (3) Leveraging requires a sequence of actions including mobilizing capabilities to form requisite capability configurations, coordinating the integrated capability configurations, and deploying these configurations with a resource advantage strategy, a market opportunity strategy, or an entrepreneurial strategy (Hitt et al., 2011; Sirmon et al., 2011). Although the managerial practices are beneficial by themselves, properly synchronizing the resource orchestration practices is essential to realize high performance outcomes (Sirmon et al., 2011).

Competitive Advantage

An organization can benefit from a sustainable competitive advantage "when it is creating more economic value than the marginal firm in its industry and when other firms are unable to duplicate the benefits of this strategy" (Kozlenkova et al., 2014, p. 4). RBT suggests that the accumulation of VRIO resources would lead to a competitive advantage, which could persist over time. In contrast, ROT highlights that resource accumulation alone is insufficient. Instead, the organization needs to structure, bundle, and leverage the resources in a synchronized approach (Hitt et al., 2011; Sirmon et al., 2011). Moreover, ROT scholars have highlighted the temporary nature of a competitive advantage. "All competitive advantages are temporary, meaning that firms must orchestrate their resources to implement strategies that help them achieve a series of temporary competitive advantages over time" (Sirmon et al., 2011, p. 1400).

Organizational Performance

Another key construct of resource management theory relates to organizational performance, which entails financial performance (profits, return on assets, return on investment, etc.), product/service market performance (sales, market share, etc.), and shareholder return (total shareholder return, economic value added, etc.)(Richard, Devinney, Yip, & Johnson, 2009). Meta-analysis research has synthesized prior empirical results and verified the positive link between resource management and organizational performance (Crook et al., 2008). In the resource management theoretical frameworks, higher organizational performance is resulting from the effective bundling of resources to form a competitive resource portfolio (Wiklund & Shepherd, 2009). Researchers have characterized the competitive resource portfolio as determining the upper limit of an organization's value creation potential (Makadok, 2003).

The Domains of RBT, DCT, and ROT

As part of the theory elaboration process, it is critical to define the setting and the circumstances where the theory can be applied (Wacker, 1998). Where and when does the theory hold? By applying the Wacker (1998) procedure of good theory building, RBT and its components were analyzed thoroughly by Tate and Bals (2017). Thus, this section's analysis will focus on the domain of DCT and subsequently ROT.

In contrast to RBT, DCT and ROT explain and predict the achievement of only a temporary competitive advantage. Both theories assume that over time, the competition will catch up and equalize any temporary advantage, regardless of its resource characteristics (Sirmon & Hitt, 2009; Teece, 2007). The resources themselves will not provide a competitive advantage because they can be copied relatively easily (Eisenhardt & Martin, 2000). The theory of dynamic capabilities focuses on the unique (re-) configuration of resources, which is an organizational capability. Being tacit, it is rather inimitable and more protectable for a longer period of time, leading to a temporary competitive advantage (Teece, 2007; Teece et al., 1997). The sole possession of resources has become less important than the actual practices of resource re-configuration (Teece, 2007) and resource exploitation (Ketchen et al., 2014). Unlike RBT or ROT, DCT has specified dynamic environments as part of its domain (Eisenhardt & Martin, 2000).

While RBT has characterized relevant resources with VRIO attributes, it has been relatively silent about HOW a firm can gain a competitive advantage (Ketchen et al., 2014). What are concrete practices to accumulate such resources (resource bundles)? How should resources be utilized to achieve a competitive advantage? DCT and ROT attempt to provide a theoretical explanation and thereby have extended RBT's theoretical domain. DCT emphasizes

that firms utilize dynamic capabilities to adapt to dynamically changing environments (Teece et al., 1997). Thus, the dynamic capabilities entail that management integrates and continuously re-arranges (reconfigures) a dynamic set of internal and external resources. RDT describes how managers can achieve a competitive advantage (even) when confronted with contextual uncertainty and unpredictable changes in their environment.

ROT provides additional details on the essential managerial practices. Learning how to acquire, bundle, and leverage the firm's idiosyncratic resources is critical to achieving a competitive advantage (Sirmon, Hitt, & Ireland, 2007). Hence, the ROT domain encompasses the necessary practices in contrast to the pure resource possession perspective of RBT. The ROT domain encompasses resources that are structured into resource portfolios. Those portfolios (sets of resources) are then bundled into capabilities (to gain a competitive advantage), which eventually are leveraged in the market place. As ROT emphasizes the managerial practices, the ROT domain is not necessarily constrained to the VRIO-type resources of the RBT domain (Sirmon et al., 2011). Contrary to DCT and RBT, however, ROT specifies three new dimensions to consider (breadth, depth, and life cycle attributes) that provide additional precision to the theory (albeit limiting its generalizability). Resource orchestration is contingent upon the different life cycle phases, the organization's strategic breadth, and the depth in regards to the different organizational levels.

To achieve a (temporary) competitive advantage, ROT suggests to synchronize the resource orchestration processes (Sirmon et al., 2011). Thus, ROT goes beyond the domain of RBT. Table 5 summarizes some of the key domain differences of RBT, DCT, and ROT.

Table 5
Comparing the Domains of RBT, DCT, and ROT

Domain Aspect	RBT	DCT	ROT
Strategic Focus	Resource Characteristics (Attributes)	Adaptation to Environment	Managerial Role (Management Practices)
Competitive Advantage Type	Sustainable	Temporary	Temporary
Source of Competitive Advantage	VRIO/VRIN Resources	Quick Adaptation to Environmental Changes by Creating Unique Resource Configurations	Optimal Synchronization of the Structuring, Bundling, and Leveraging Sub-Processes

The Relationships of RBT, DCT, and ROT

In this section, the logical connection of constructs to others will be explained. The internal consistency of theory is demonstrated by addressing the questions of how and why constructs are related or unrelated (Wacker, 1998). While reviewing the literature, the Wacker (1998) procedure has been applied to decide which relationships among constructs are important and to compare the three theoretical frameworks of RBT, DCT, and ROT.

RBT emphasizes the organization's own ability to utilize and leverage resources to create unique capabilities and develop a competitive advantage rather than being (passively) impacted by external market factors (Prahalad, Hamel, & June, 1990). Hence, RBT posits that the organization's resource portfolio determines its strategic opportunities and thus has an impact on organizational performance (Wernerfelt, 1984). The organizational resource portfolio can serve as a barrier to entry and thereby substantially influence the competitive situation (Vivek, Banwet,

& Shankar, 2008). Exploiting a competitive advantage can enhance organizational performance. In summary, RBT posits that a portfolio of strategic resources with VRIO attributes can lead to a competitive advantage, which can result in higher organizational performance.

DCT emphasizes the managerial role of (re-)combining resources as a fundamental activity to enhance organizational competitiveness (Sirmon, Hitt, & Ireland, 2007). According to the dynamic capabilities theory, firms gain a competitive advantage by building new resource configurations (Eisenhardt & Martin, 2000). DCT predicts that resource re-deployment or modification can lead to an at least temporal advantage compared to other firms (Teece, Pisano, & Shuen, 1997). Specifically, "flexible strategies to coordinate and redeploy resources" (Yalcinkaya, Calantone, & Griffith, 2007) can improve the organization's competitiveness.

In conclusion, RBT, DCT, and ROT all attempt to predict firm performance. While RBT emphasizes resource characteristics (VRIO attributes) and corresponding resource strategies, DCT and ROT both focus more on organizational practices. When the focal organization is more successful in implementing effective resource management practices (orchestration or re-configuration), then it should be able to experience a competitive advantage (Hoopes & Postrel, 1999). According to DCT, the effective resource (re-) configuration would enable the focal organization to better adapt when facing dynamic environmental changes and thereby create a competitive advantage (Winter, 2003). In this way, resource management can substantially influence the performance of an organization (Wiklund & Shepherd, 2003). Existing research on DCT and ROT has explained a performance impact of resource management on the basis of effective configuration and/or orchestration of company-internal resources. Hence, the appropriate re-configuration and coordination of internal resources has been linked to a competitive advantage.

Predictions of RBT, DCT, and ROT

For RBT, DCT, and ROT, the portfolio of resources is instrumental in achieving a competitive advantage. But the suggested mechanism is different in detail for each theoretical lens. For RBT, resource characteristics are essentially predicting performance differentials. For the latter two lenses, however, managerial practices of coordination, integration, (re-) configuration, or orchestration of resources play a decisive mediating role (Wiklund & Shepherd, 2009). Such practices can be understood as organizational capabilities that demonstrate similar characteristics (VRIO) as the underlying resources of RBT. Those practices are typically valuable, rare, difficult to imitate, and require an appropriate structure (organization or governance model) to be effective. In essence, such managerial practices (resource management capabilities) are highly tacit resources themselves.

Figure 2 illustrates the predictions of RBT, DCT, and ROT. According to RBT, a portfolio of VRIO resources can lead to a competitive advantage, which then can result in higher performance. However, ROT and DCT postulate that an additional mediator plays a decisive role. Either the managerial practices of resource (re-) configuration (DCT) or resource orchestration (ROT) are essential in influencing the performance impact of resources (Figure 2). In the context of innovation processes, for example, DCT would suggest that building appropriate resource management capabilities and adapting them to the dynamically changing environment would lead to better innovation outcomes and ultimately result in a competitive advantage (Grant, 1991; Hoopes & Postrel, 1999). Accordingly, an organization that continuously shapes and adapts their essential resource configurations (portfolio) would achieve competitive benefits and higher organizational performance (Yli-Renko et al., 2001). Likewise, effective resource orchestration practices would lead to a temporary competitive advantage.

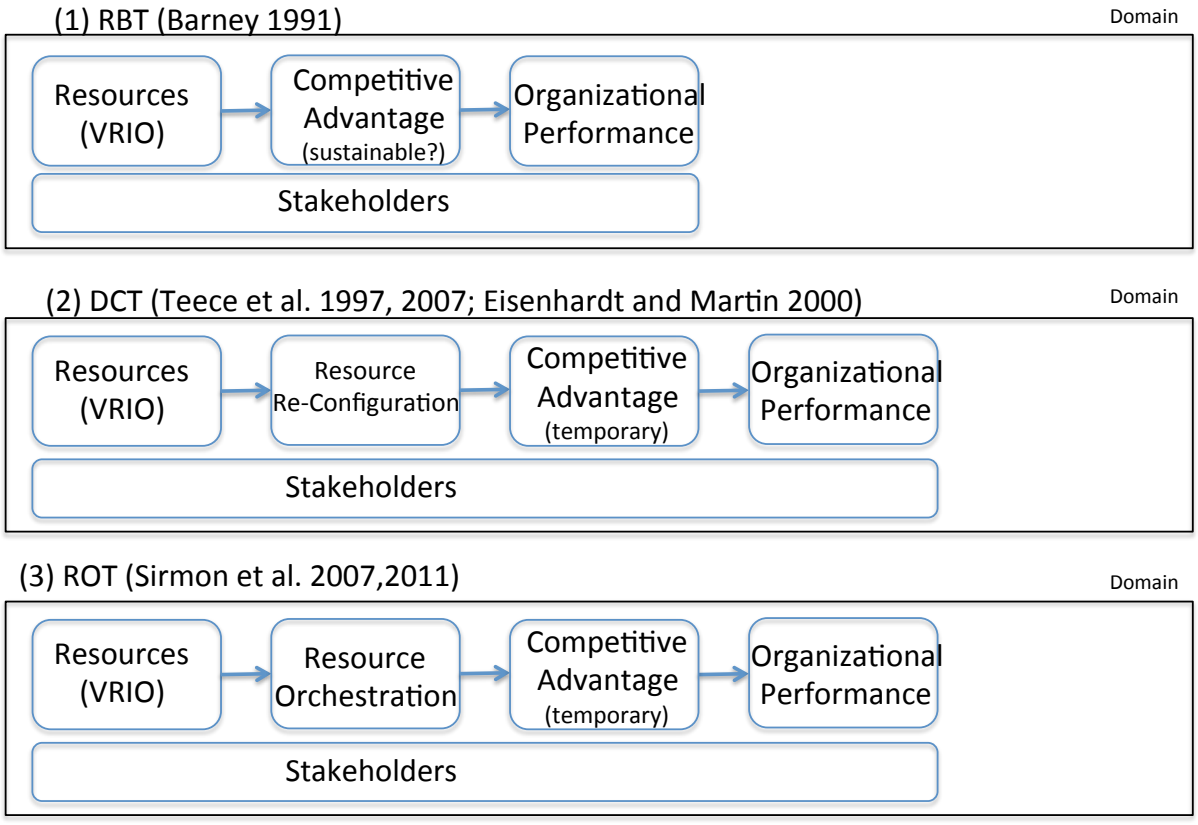

Figure 2 - Constructs, Domain, Relationships, and Predictions of RBT, DCT, and ROT

Toward a Theory of SCRO

The possession of strategic resources does not automatically lead to a competitive advantage. "What a firm does with its resources is at least as important as which resources it possesses" (Hansen et al., 2004, p. 1280). These resources must be orchestrated efficiently and effectively so that organizations might achieve superior performance (Sirmon et al., 2007). However, the deployment of resources tends to be idiosyncratic and highly contextualized (Ireland, Hitt, & Sirmon, 2003) depending on situational factors and managerial interpretations and perspectives (Sirmon et al., 2007). Hence, effective resource management necessitates considering environmental implications. Extending the logic of RBT, supply chains could be characterized as bundles of tangible and intangible resources (Braunscheidel & Suresh, 2009; Ireland et al., 2003). Due to higher resource management complexity of resource integration from external sources, organizations need to develop and understand a systematic approach to resource management (Wiklund & Shepherd, 2009), which can be described as supply chain resource orchestration (SCRO) (Baert et al., 2016). Recall that SCRO is effectively managing the external resource inflow into the organization including the resource acquisition, integration, and exploitation processes.

Innovative and well-performing organizations require an effective process to identify, acquire, integrate, and exploit the appropriate external resources to establish a competitive resource portfolio (Crook & Esper, 2014). This necessity relates well to the core of SCRO because, in essence, SCRO can be characterized by the following essential attributes. First, SCRO describes a systematic approach to managing essential supply chain resources for the organization. This involves the synchronized structuring, bundling, and leveraging of internal and external resources to gain a competitive advantage.

Construct Definitions in SCRO

In this section, the main constructs of the SCRO framework are introduced. Supply chain resource orchestration is analyzed in terms of essential theory components and contrasted to RBT, DCT, and ROT. From an SCRO perspective, it is necessary to differentiate between internal and external resources. In general, resources are tangible and intangible assets (Kozlenkova et al., 2014) and can include "capabilities, organizational processes, firm attributes, information, knowledge, etc." (Madhavaram & Hunt, 2008, p. 67). Importantly, a SCRO resource portfolio includes both internal firm and external supply chain resources (accessible to the focal organization) (Allred & Swan, 2014).

While RBT, DCT, and ROT mainly treat resources as internal and fully controlled by the focal organization (Sirmon et al., 2011), there are relevant, external resources that are not fully controlled by the focal firm but are acquired from external organizations (Ketchen et al., 2014). Supply chain resource orchestration considers the external processes that lead to services and products being acquired, and those processes can be considered as a critical capability themselves (Eisenhardt & Martin, 2000). SCRO is characterized by an effective resource integration, which means a blending of external with existing internal resources (Das, Narasimhan, & Talluri, 2006). Organizations require such coordination practices to thrive.

Since SCRO is based on ROT, the new SCRO framework entails the resource orchestration terminology of (Hitt et al., 2011, p. 64), who define structuring as acquiring, accumulating, and divesting essential supply chain resources from external constituents. Accordingly, bundling relates to integrating external (SC) resources and blending them with in-house internal resources to enhance innovation processes. Thereby, bundling involves stabilizing existing capabilities, enriching existing organizational capabilities with complementary external

resources, and pioneering new capabilities within the organization. Hitt et al. (2011) define leveraging as the exploitation of the newly formed, blended capabilities. Such practices encompass the capability configuration and deployment according to market needs. Within the innovation literature, scholars have noted the criticality of leveraging processes to successfully conclude the utilization of resources from supply chain partners (West & Bogers, 2014).

Organizational culture is another important concept to consider. The effectiveness of supply chain resource orchestration depends upon establishing a firm-wide understanding and acceptance of a common purpose to make such coordination more effective (Braunscheidel & Suresh, 2009). This relates to two aspects. First, SCRO needs to be aligned with the overarching corporate strategy (e.g., including innovation and financial targets). Second, cultural aspects influence the performance outcomes of orchestration decision-making (Knudsen et al., 2011). Organizational culture is influencing the performance outcomes of resource management practices.

Organizational culture has been described as a "system of shared values" (Ireland et al., 2003) and can be structured in three layers of values, norms, and artifacts (Hock, Clauss, & Schulz, 2015). Deeply rooted (and sometimes subconscious) values and beliefs of the organization are its cultural foundation. They are invisible but "very influential and refer to the organization's ideology and philosophy" (Hock et al., 2015). The second layer consists of organizational norms (behavioral expectations). Finally, the third layer relates to artifacts, which are visualizing the underlying values in organizational symbols. For the SCRO framework, organizational culture plays a decisive role, which will be explained in the subsequent sections.

Toward a Broader Domain in SCRO

Where and when does the new emerging SCRO theoretical framework hold in comparison to RBT, DCT, and ROT? This section describes how SCRO is extending ROT to a broader domain (Wacker, 1998). To date, resource management literature has primarily emphasized the configuration and/or orchestration of company-internal resources. However, the theoretical domain of ROT can be expanded when investigating the orchestration of relevant resources of the supply chain.

When an organization effectively manages the resource inflow from its supply chain and its subsequent integration and exploitation, then this should affect the competitive position (Wang & Zajac, 2007; Wiklund & Shepherd, 2009). In this way, the resource-based theoretical domain can be extended to encompass the supply chain resource orchestration phenomenon. SCRO relies on the assessment of whether internal or external resources are more beneficial to use for a specific innovation process (make or buy decision) (Hitt, 2011). When SCRO is done effectively, an optimal resource mix can be orchestrated and commercialized by the focal organization.

Scholars have observed that the locus of innovation has shifted in many industries from the organization to a supply network (Hoopes & Postrel, 1999; Powell, Koput, & Smith-Doerr, 1996). Due to this shift, resources provided by external suppliers have become more important. Consequently, the theoretical resource management domain needs to accommodate for this changing phenomenon. There is a need to broaden the scope of resource management theory beyond its current theoretical space to consider the origin of resources, external stakeholders, and implications of organizational culture. Hence, with this study, the resource management theory is expanded below in terms of three major tasks:

- Specify the origin of resources (include external resources and its corresponding processes) as this shows direct influence on resource management practices
- Add a cultural dimension (e.g., firm-level innovation culture), which entails a moderating influence on the relationship between the resource management capability and the competitive advantage (firm performance)
- Enhance the theoretical depth of ROT by detailing the SCRO sub-processes

The utility of SCRO is higher than ROT because SCRO has a wider domain and is applicable to both internal and external resources. SCRO is extending both the breadth and depth of ROT. Thereby, SCRO is fulfilling the virtue of good theory as it shows higher generalizability than ROT (Wacker, 1998). ROT is only concentrating on the focal organization itself. Sirmon et al. (2011) defined the breadth of ROT and limited it to the internal, organizational scope.

To conclude, SCRO can broaden the scope of scholarly attention beyond purely internal, fully self-controlled resources. Consequently, different managerial actions become essential for effective external resource management. Applying the prior work of Sirmon et al. (2011) and other scholars, the theoretical lens of SCRO should extend the existing resource-management theoretical domain by emphasizing the role of managerial practices of structuring, bundling, and leveraging resources.

Relationships Among Constructs and Predictions Based on the SCRO Framework

In this section, the relationships among constructs within the SCRO framework as well as the corresponding research propositions (predictions) are developed based on the literature and prior elaboration. How does SCRO affect the competitive position of an organization? How is

organizational performance in general, and innovation performance in particular, affected by SCRO practices? What are the decisive logical connections among the key constructs in the emerging SCRO framework?

Individual resources can frequently be imitated by competitors and thus cannot create a sustainable advantage (Teece, 2007). The competitive value of SCRO practices lies in its context-adapted resource management practices, not in the accumulation of individual resources themselves (Eisenhardt & Martin, 2000). Existing resource management research based on DCT or ROT has mainly emphasized the (re-) configuration and/or orchestration of company-internal resources. However, it appears plausible to broaden this mechanism to include the re-configuration and orchestration of external resources provided by the supply chain (Yli-Renko et al., 2001). Therefore, the SCRO framework primarily encompasses the relationship between resources (internal and external), supply chain resource orchestration practices, and organizational performance, along with organizational culture.

Effectively executed SCRO practices can be understood as dynamic capabilities that are valuable, rare, inimitable, and nonsubstitutable and serves as competitive advantage (Eisenhardt & Martin, 2000; Teece, 2007). These competitive capabilities result from the sub-processes of resource structuring, bundling, and leveraging efforts. The literature has already suggested the positive performance impact of dynamic capabilities on organizational performance (Teece, 2007). Given that SCRO practices can be understood as dynamic capabilities, this positive relationship with performance should prevail as well.

There is one additional relationship to be explored, which is depicted in Figure 3. The management literature suggests that organizational culture might play a role when analyzing resource management performance (Hitt et al., 2011, p. 58). As it relates to the innovation

context, culture largely determines both the perceived freedom to generate new ideas and suggest new approaches, and the attentiveness of the organization to such emerging innovative ideas (Narasimhan & Narayanan, 2013). Cultures may also be differentiated in terms of how embedded the value of innovativeness is throughout the organization: Is innovation understood as purely functionally delegated (e.g., to the R&D function) or as an underlying responsibility for all employees (Chen, Chen, & Vanhaverbeke, 2011)? Has innovation been accepted as a basic value throughout the organization (Knudsen & Mortensen, 2011)?

Within traditional resource-based theoretical frameworks, there has not yet been much discussion on how resource management capabilities impact performance under the influence of organizational culture. Nonetheless, it can be implied that culture might influence the performance consequences of resource management (Kleinschmidt, De Brentani, & Salomo, 2007). This is particularly probable for involving external resources. Outside of the resource-based theories, organizational cultural influences on performance have been investigated, particularly in regard to innovation performance (Knudsen & Mortensen, 2011). Organizational culture is important for innovation processes because culture affects not only internal behaviors but also the way organizations build relationships externally.

Culture can stimulate innovative behavior because it determines the commitment toward continuous innovation (Knudsen & Mortensen, 2011). Finally, organizational culture affects the orientation and mindset of an organization, and thereby influences innovation performance as well. For example, a company with an external focus (outwardly oriented) might be more inclined to enhance communication and exchanges with other companies and thereby have earlier or easier access to scarce information (Knudsen & Mortensen, 2011). Such an external focus can include tendencies regarding customer orientation and competitive aggressiveness,

which all affect, ultimately, innovation and financial performance. Thus, the SCRO framework includes the concept of organizational culture with its two dimensions of innovation culture and efficiency culture, which are expected to directly affect innovation performance. In addition to those direct effects, Figure 3 illustrates how innovation and efficiency culture can also moderate the SCRO to performance relationship.

When analyzing organizational culture, the differentiation between an innovation culture from an efficiency culture is important for the purpose of clarity. Both are understood as residing on opposing ends of a dichotomy (Hock et al., 2015; Knudsen & Mortensen, 2011). Innovation culture has been described with attributes such as innovation orientation, creativity, risk-taking, or pioneering, among others (Table 6). In contrast, key attributes of efficiency culture include productivity, stability, control, or consistency. This decisive relationship between organizational culture and innovation performance, as described above, leads to the first two propositions:

Proposition P_1:

Innovation culture is positively associated with innovation performance.

Proposition P_2:

Efficiency culture is negatively associated with innovation performance.

Scholars have identified and described a number of different facets related to innovation and efficiency culture. Table 6 summarizes the main aspects of those two important manifestations of organizational culture in the literature.

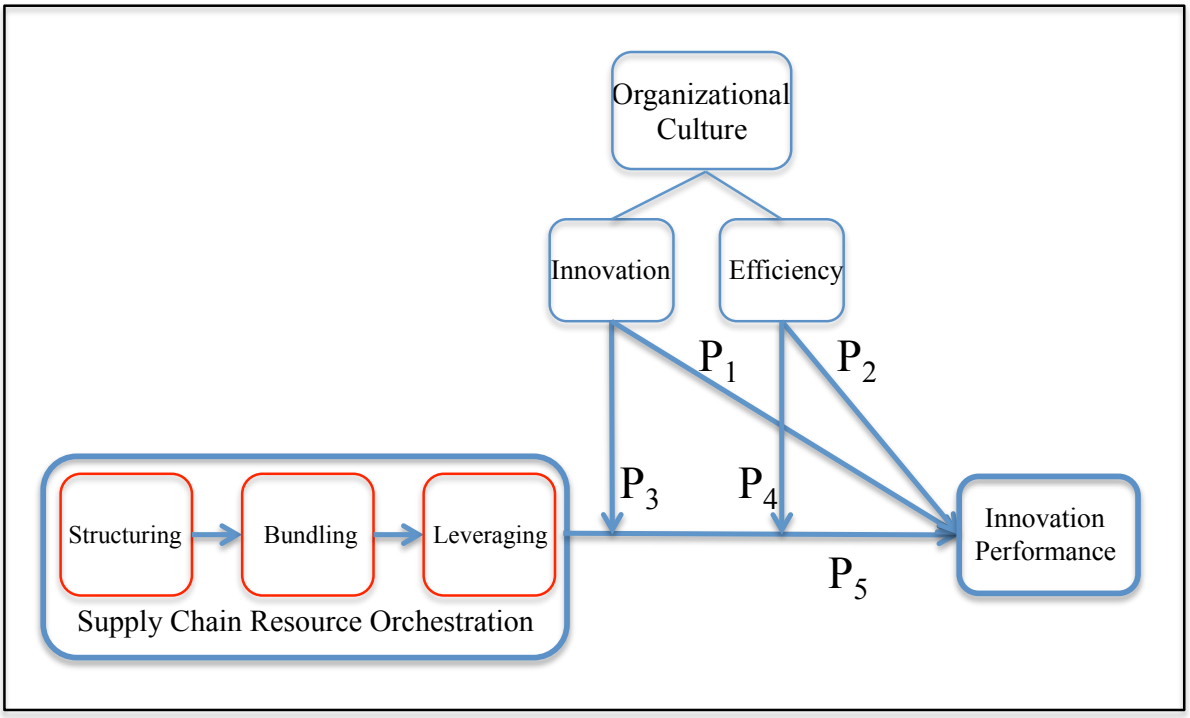

Figure 3 - Organizational Culture

Table 6
Innovation and Efficiency Culture

Type	Description	Source
Innovation Culture	Innovation Orientation / Innovation Posture / Innovation Propensity / Novelty-oriented	Dobni (2008); Knudsen and Mortensen (2011); Calantone and Rubera (2012); Schmelzle et al. (2017)
	Creativity / Thinking Outside-the-box	de Brentani and Kleinschmidt (2004); Knudsen and Mortensen (2011)
	Risk-Taking (Rewarding Risk-taking)	de Brentani and Kleinschmidt (2004); Kleinschmidt et al. (2007); Knudsen and Mortensen (2011); Narasimhan et al. (2013)
	Pioneering Character / Willingness to Experiment / Exploration	Knudsen and Mortensen (2011); Wei et al. (2013); Narasimhan et al. (2013)
	Climate of Openness / Openness to Innovate / Receptive to New Ideas / Challenging New Ideas	de Brentani and Kleinschmidt (2004); Kleinschmidt et al. (2007); Dobni (2008); Chen et al. (2011); Narasimhan et al. (2013)
	Outward-oriented / External Focus / Market Orientation	Dobni (2008); Knudsen and Mortensen (2011)
	Anticipating Market Changes / Proactiveness / Adaptability / Flexibility & Change	de Brentani and Kleinschmidt (2004); Knudsen and Mortensen (2011)
	Competitive Aggressiveness	Cooper et al. (1989); de Brentani and Kleinschmidt (2004); Knudsen and Mortensen (2011)
	Entrepreneurship	de Brentani and Kleinschmidt (2004); Kleinschmidt et al. (2007); Knudsen and Mortensen (2011)
Efficiency Culture	Efficiency / Productivity / Exploitation / Reducing Transaction Costs	Knudsen and Mortensen (2011); Hock et al. (2015)
	Stability / Coordination	Knudsen and Mortensen (2011); Hock et al. (2015)
	Control / Organizational Governance / Organizational Structure	Knudsen and Mortensen (2011)
	Consistency	Hock et al. (2015)
	Decision-making Process / Policies and Procedures / Rules & Regulation / Routines	Emden et al. (2006); Knudsen and Mortensen (2011); Hock et al. (2015)
	Internal Orientation / Internal Focus	Knudsen and Mortensen (2011)
	Imitation Orientation	Knudsen and Mortensen (2011)

Furthermore, the organizational culture construct is predicted to moderate the competitive advantage and organizational performance impact of SCRO. Hence, the following is suggested:

Proposition P_3:

Innovation culture positively moderates the relationship between SCRO and innovation performance.

Proposition P_4:

Efficiency culture negatively moderates the relationship between SCRO and innovation performance.

Innovation culture can moderate the relationship between supply chain resource orchestration and performance. The next critical relationship addresses the performance implications of SCRO. The SCRO framework can help explain organizational performance in general. In particular, it can also predict innovation performance, which can often yield a competitive advantage and, ultimately, enhance financial performance. Figure 3 above illustrates this important relationship between SCRO and innovation performance along with the moderating influence of efficiency and innovation culture.

How does SCRO impact performance? Using a theory elaboration approach, the resource management theory is broadened to explain how SCRO affects the performance of an organization. Applied to the context of innovation processes, SCRO would suggest that building and coordinating a dynamic resource orchestration capability will result in more effective innovation processes and enable gaining a competitive advantage (Eisenhardt & Martin, 2000;

Hoopes & Postrel, 1999). Accordingly, a firm with a (strategic) commitment to enhance SCRO practices and to actively shape these essential supply chain-wide resource configurations should be able to reap these competitive benefits. Hence, these arguments elicit the next proposition:

Proposition P_5:

Supply chain resource orchestration is positively associated with innovation performance.

Finally, the outcome of SCRO is dependent upon the inflow and use of external resources. Thus, the value and performance impact of SCRO is based substantially on orchestrating internal with external resources. Thereby, the organization will achieve a competitive advantage when external resources are utilized effectively and efficiently. Accordingly, the importance of external resources leads to the following proposition:

Proposition P_6:

An increased use of external resources is positively associated with the level of supply chain resource orchestration.

In Figure 4, the complete (innovation-driving) supply chain resource orchestration framework is illustrated. Both internal and external resources can influence the development of a competitive advantage but necessitate SCRO as a mediator. Furthermore, organizational culture is moderating this relationship between SCRO and innovation performance. As the latter influences the competitive position of the organization, achieving a competitive advantage will ultimately lead to higher financial performance.

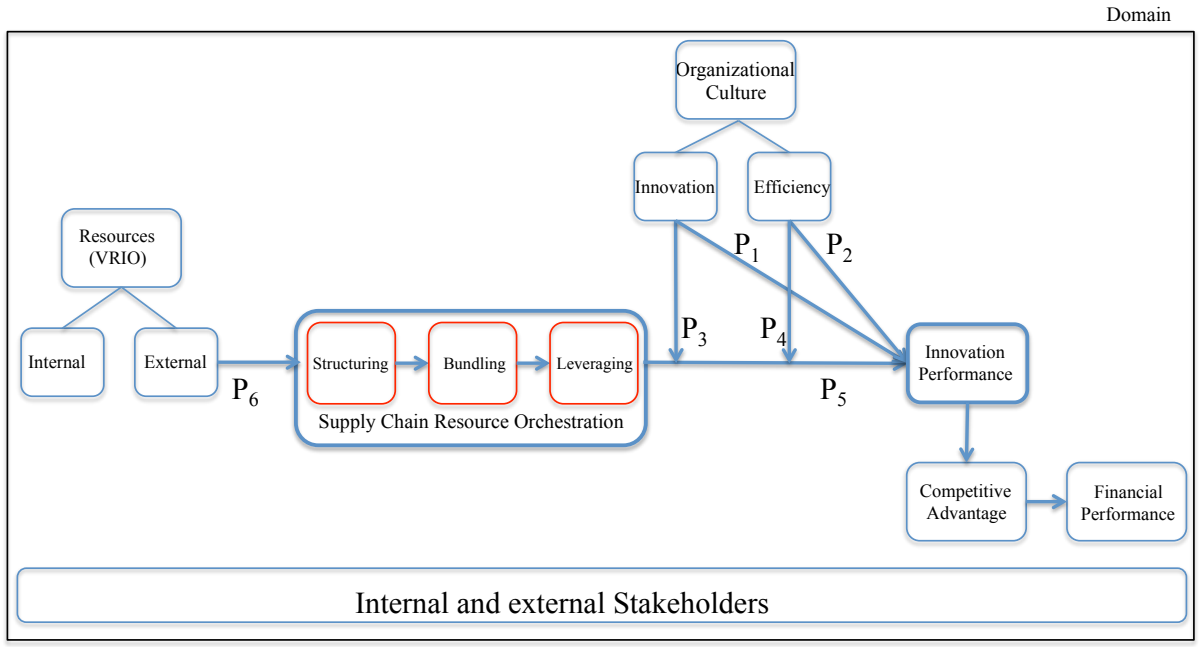

Figure 4 - SCRO Framework

Methodology

Theory elaboration can be understood as "disciplined iteration between general theory and the empirical data" (Ketokivi & Choi, 2014, p. 236). Now that the previous chapters have assessed the relevant resource management theories and explained the conceptual development of SCRO, the subsequent case study will assist in enriching the understanding of SCRO. The empirical data provides a complementary perspective and fleshes out the phenomenon from another angle.

While the overall purpose of applying a theory elaboration methodology (Ketokivi & Choi, 2014) was to extend the existing resource orchestration theory, the case study method was used to obtain empirical data as complementary support in addition to the literature. The use of multiple cases allows for a more robust, generalizable, and parsimonious theory elaboration than single cases (Eisenhardt & Graebner, 2007) and can enhance the richness and precision of the

theory (Yin, 2014). Case studies are also especially useful for developing theoretical insights when the research focuses on areas that extant theory has not yet fully addressed to date (Eisenhardt & Graebner, 2007). Using multiple cases in contrast to a single case has proven to be effective as it allows for the collection of comparative data. Therefore, researchers have emphasized the higher likelihood of multiple case studies yielding accurate, generalizable theory than single cases (Eisenhardt, 1989; Ozcan & Eisenhardt, 2009; Yin, 2014).

In total, 24 semi-structured interviews were recorded, transcribed, and coded. After the initial open coding step was completed, more abstract categories were developed by comparing the coding results from different cases (Corbin & Strauss, 2008). Eventually, relationships among those categories emerged (Miles & Huberman, 1994). Replication logic (Yin, 2014) was applied by verifying the applicability of new categories for each case. Some categories applied across all cases (e.g. managing customer needs) while others applied only to a subset of cases (e.g., purchasing strategy).

Thus, the SCRO framework was refined and validated iteratively by comparing observed categories between cases (Eisenhardt, 1989). Following the constant comparison approach during the analysis, newly emerging categories from the cases were refined by looking at the theoretical literature in an iterative cycle of induction and deduction. Some categories were discarded when they failed to replicate across other cases (Martin & Eisenhardt, 2010).

Research Setting

The context for this research is the high technology equipment industry, in which organizations develop new products and services and rely on input from key suppliers. This setting was appropriate for several reasons. First, studying organizations from a relatively similar industrial

context enables a more valid and thorough comparison of organizations. Second, this industry environment has demonstrated a high inclination for joint development with the supply network because organizations have come to realize that they can no longer effectively innovate on their own. In other industrial settings, this awareness might not prevail to a similar degree so the phenomenon cannot be investigated at the same depth. Overall, the interviews with the participating organizations yielded insightful and relevant data about the management of external resources in joint new product/service development projects.

The research encompasses several organizations ranging from mid-size (around 3,500 employees) to large multinational corporations. Due to the variety in firm size and age as well as market competitiveness, the likelihood of observing diverse supply chain practices is increased. Six companies were selected and grouped into five cases. The organizations are producing technology equipment in the high technology, automotive, and transportation/logistics equipment industry.

Case Study Data Collection

A number of different data sources were utilized: (1) interviews, (2) follow-up e-mails and phone calls for verification, triangulation and clarification, and (3) publicly available information, including company websites, corporate press releases, general business news websites (e.g., wsj.com), and commercial databases (e.g., Mergent Online). Using diverse sources of information provides a richer, multi-angled perspective and thereby enhances confidence in the validity and precision of the theory elaboration process. Furthermore, the extensive professional experience of the principal investigator in new product development within a high technology environment stipulated a thorough contextual understanding of the phenomenon.

In total, 24 semi-structured interviews plus follow-ups were conducted. Each interview lasted for about 45–90 minutes and was recorded and transcribed. The interviews were conducted with managers involved in new product development (NPD) who held a number of different supply chain-related positions (refer to Table 7 for details). This diversity of perspectives gave the data depth and breadth, providing a multi-faceted perspective rather than a purely single-function sense of the phenomenon.

Potential informant bias was minimized by taking several measures. First, the research involved highly experienced and knowledgeable participants who spoke about relatively recent, important events and decisions of their main professional environment and circumstances. Such a set-up can be expected to generate relatively accurate statements. The issue of potential recall bias is addressed as the most recent NPD project was selected by the initial participant as the focus project (Hallen & Eisenhardt, 2012).

Second, for each case, we triangulated data from multiple participants. Third, we assured anonymity for both the participants and the organizations, thereby fostering an open, trustful interview environment. Finally, the participants were very motivated to be accurate because they were highly interested in learning how to enhance the innovation performance of their organizations and in learning about potential best practices. When participants are highly motivated, more accurate claims can typically be expected (Hallen & Eisenhardt, 2012). Additional empirical data with important contextual or demographic information from publicly available sources was utilized to complement the interview data. Financial reports from the case organizations were retrieved for the years 2013-2015 to calculate the growth/decline in terms of revenue and earnings/losses (Table 7).

Table 7
Overview of the Cases

Criteria	(TECH-1)	(TECH-2)	(LOG)	(AUTO)	(EQUIP)
Interviews: 24	8	4	4	4	4 (2 firms)
Primary Functions (of participants)	Purchasing, R&D, Supply Chain	Purchasing, Supply Chain	Manufacturing, R&D, Supply Chain	Purchasing, R&D	Manufacturing, Logistics, Supply Chain
Industry	Technology	Technology	Logistics Equipment	Automotive / Specialty Equipment	Technology Equipment / Automotive
Region (of participants)	Europe	U.S.	U.S.	U.S.	U.S. / Asia
Revenue (estimation)	$60 billion	$90 billion	$2.6 billion	$3 billion	$70 billion *
Employees (estimation)	135,000	150,000	5,500	11,000	105,000*
Firm Age (estimation)	50 years	100 years	80 years	100 years	70 years*
Revenue growth (2013 – 2015)	8.8%	11.0%	-3.3%	20.4%	-5.1%*
EBIT growth (2013 – 2015)	82.9%	12.9%	-31.9%	52.5%	-34.0%*

*Average of Both Firms

Case Selection (Sampling)

A theoretical sampling approach was applied (Eisenhardt, 1989). The cases were selected purposefully as they are "particularly suitable for illuminating and extending relationships and logic among constructs" and likely to offer substantial theoretical insights (Eisenhardt & Graebner, 2007, p. 27). While random sampling is typically applied for deductive research using statistical analysis, this inductive case study applied theoretical sampling that was purposefully nonrandom. Each case was selected on the basis of providing a useful perspective of the focal phenomenon and thereby supporting the theory elaboration process. In this way, using multiple applicable cases boosted the finding's generalizability and enriched/substantiated the emerging theoretical conceptualization (Eisenhardt, 1989). Using the snowballing technique, the first interview participant was requested to identify additional relevant people in the organization to participate in the study.

The theoretical sampling approach led to selecting organizations with new product development activities that involved substantial input from suppliers. The focal phenomenon was evident in each selected case. Organizations with only minor supplier involvement in NPD were

not selected because they did not fulfill this condition. The use of theoretical sampling should improve the generalizability of the study (Hallen & Eisenhardt, 2012).

Validity and Reliability

A number of steps were taken a priori in the research design and post hoc after data collection to ensure and verify the validity of the findings. The accuracy of the findings was verified by employing recommended procedures (Creswell, 2014; Yin, 2014). To enhance internal validity, for example, different types of information were analyzed (data triangulation). To verify the accuracy of initial findings, the author conducted member checks in follow-up conversations with some key study participants. Peer debriefings with uninvolved scholars were used to discuss findings and check the conclusions for potential logical flaws. Table 8 summarizes how the four main criteria were applied in the study.

To address the research questions and elaborate the theory (Ketokivi & Choi, 2014), the inductive case study approach was used. Using the existing resource orchestration theory as a starting point, the supply chain resource orchestration practices of the participant organizations and potential corporate culture implications were applied. The following cross-case analysis and case discussion describes relevant SCRO categories and sub-categories developed during the iterative process.

Case Analysis and Discussion

The conceptual model and the research propositions are based on literature and theory, as outlined in the previous sections. However, the theory-based picture remains incomplete. Hence,

Table 8
Validity and Reliability

Criteria	Meaning	Application in this Research Study
Construct Validity	Research measures what it is intended to measure	• Incorporating multiple sources of evidence (e.g., multiple informants, secondary data, empirical and conceptual literature) • Verifying the initial findings with other scholars and practitioners
Internal Validity	Relationships among constructs are demonstrated and conclusions can be drawn	• Triangulating data (interview data, secondary data, academic and practitioner-oriented literature) and supplementing interview data with other data sources (publicly available information) • Conducting member checks (review of findings by and discussion with practitioners) • Reviewing study findings with uninvolved scholars
External Validity	Results can be applied to the population of interest. A domain is established in which the findings can be generalized	• Using multiple respondents and multiple industrial contexts for the interviews • Sampling purposeful and including organizations from the U.S., Asia and Europe
Reliability	Repeatability is demonstrated	• Applying an interview guide with common questions • Using NVivo software for coding, annotating, and memo-writing • Developing a case study repository with multiple data sources (interview data, secondary data, and literature)

Source: Creswell, 2014; Tate & Ellram, 2012; Yin, 2014

the following analysis of the case evidence collected provides additional insights and important new perspectives from practitioners to complement the prior conceptual development.

In this section, the interview data are analyzed and related to the four main concepts of resources, supply chain resource orchestration, organizational culture, and organizational performance. Each organization revealed a different approach to the management of external resources and noticeable differences in terms of innovation culture. Most importantly, the interviewed managers illustratively described important SCRO practices and its implications. The interviews also revealed their companies' organizational culture and indicated the level of fit with their SCRO practices. The case analysis offers some validation of the conceptual model and enriches the model. Furthermore, the cross-case analysis substantiates the theoretically derived propositions and leads to interesting future research questions.

In terms of the research propositions, the key questions to be addressed concern whether SCRO practices influence innovation performance and how organizational culture comes into play in this relationship (directly or indirectly). The case study evidence, along with conceptual literature, appears to sustain a positive influence of SCRO and innovation-oriented culture on innovation performance. First, the interviews with supply chain managers indicate that managerial practices related to fostering integration, coordination, and trust-building can be viewed as essential building blocks to enhance innovativeness in the organization.

Second, the case study findings substantiate the SCRO framework's assumption of cultural influences. Based on the interview analysis of supply chain managers, innovation appears to flourish less in more cost- and efficiency focused environments. In the iterative cross-case analysis of these organizations, distinctions between innovation-emphasizing and cost-emphasizing organizations emerged. As the interview participants highlighted their managerial

lessons learned and shared their performance outcome experiences, the right balance between SCRO practices and either innovation or cost-focus appeared to be imminently important for them. Some organizations appeared to be "stuck in the middle" between innovation and cost focus. This situation led to a mismatch of their SCRO practices to their culture, with detrimental impact on their financial performance.

The following analysis offers essential case study evidence about the SCRO framework. The data substantiates and summarizes the important managerial perspectives of the two main concepts of supply chain resource orchestration and innovation culture. Recall that SCRO relates to the relevant processes of managing the acquisition, integration, and exploitation of critical external resources. Based on the literature, innovation culture has been defined as an organizational "orientation toward experimenting with new alternatives or approaches by exploring new resources, breaking through existing norms, and creating new products" to improve organizational performance (Wei, Neill, Lee, & Zhou, 2013, p. 1029). This section summarizes the case study findings toward the concepts of resources, SCRO, organizational culture, and organizational performance.

Resources (Internal and External)

Organizations seek the effective and efficient configuration and (re-) combination of internal and external resources to develop new capabilities (Teece, 2007). They require an effective integration of both internal and external resources to stay competitive. Critical resource attributes (Barney, 1991) as well as the managerial practices in dealing with resources are relevant to this effort. While the dynamic capability literature has emphasized the ongoing resource re-

configuration as critical, ROT has emphasized the aspect of synchronizing resource orchestration practices (Teece, 2007; Sirmon et al. 2011).

The case study interviews revealed additional, interesting insights from the practitioners, especially in terms of external resources. One interesting revelation is the emphasis that participants gave to the suppliers' processes. For example, managers from TECH-2 or LOG described how the recognition of a supplier's superior processes has led to a change in the supply base. For instance, new suppliers have excellent R&D capabilities but also have established processes to facilitate access to R&D funding from outside (governmental) sources.

> "… [*We*] had several meetings with our core team and our core strategy team and actually developed an alternative supply base of suppliers that we want to actually grow because they do have good quality. They are cooperative and they can provide other benefits because they can access government funding, be in U.S. or international government funding. They have robust R&D technology capabilities themselves." (Hannah, TECH-2)

> "… I have my engine supplier sitting down with my engine engineer. We sit down and look at the target. We look at all the process for getting there, how we can make this at this price." (Thomas, LOG)

In contrast, the managers noted that poor performing suppliers lack essential process capabilities in terms of lean manufacturing or design for manufacturability.

> "… you [*the supplier*] need [*our*] help in terms of lean manufacturing expertise, value engineering changes to make things more producible." (Hannah, TECH-2)

Thus, TECH-2 and LOG considered the suppliers' processes as critical external resources, determining the target products and services to be procured. Both firms evaluated the quality of the entire process leading to the supplier's final output (end product or service). Nonetheless,

TECH-2 noted that they had undergone a learning process in the past. They recognized the need to pay more attention to the details of the upstream supply chain process resources and capabilities.

> "… We spent a huge amount of time and money doing production readiness and digging into our tier one supply chain because, frankly, that's where we found most of our failures, was way way down in the supply chain. We're talking tier four, tier five. We had no clue that it was so deep and so I would say that is an area that we're certainly more aware of, and we spend a lot of energy managing it." (Hannah, TECH-2)

The category of internal resources is very broad and diverse. The managers mentioned both tangible (e.g., financial and human resources) and intangible resources (e.g., a process to share information or a systematic procedure to deal with engineering changes). Many aspects relate to cross-functional integration with aspects of communication, cooperation, collaboration, and coordination practices. For example, managers from AUTO, EQUIP, and TECH-2 described some core internal resources as follows.

> "…I think the communication exchange, … the communication stage has to cover all the different functions, whether it's the marketing information that's transmitted across volume and the calendarization of that volume just for seasonality to pricing and cost of raw materials. There needs to be some level of sharing."(Rodney, AUTO)

> "…we have this problem. We have a plan. We need to make sure it happens." Now there's an … in a system that we're tracking and they have to come back with a formal corrective action plan and there's a formal process in which it gets closed out, so that everybody understands and agrees." (Amy, EQUIP)

> "…I would say though generally, it's preferred that we align internally and go out as a united front." (Hannah, TECH-2)

Several organizations highlighted the issue of internal resource constraints, especially in regard to tangible resources such as financial and human resources.

> "…There are some constraints there in terms of the number of resources, especially if you don't recognize that a big part of that process is going to take time. … that's going to reduce the amount of time they can work on the projects they're working on now" (Brandon, AUTO)

> " … Where we run into problems is when many different projects are launching at the same time for different development centers. Then we start running into manpower issues." (Hunter or Bob, LOG)

> "… there's a big knowledge gap and skill gap right now that we're dealing with." (Hannah, TECH-2)

Finally, an effective organizational learning process can be considered as an internal resource as well. Some companies have struggled to establish cross-functional learning or have neglected the importance of internal transfer of knowledge within the organization. In the case of EQUIP, the managers noticed that the cross-program information flow was particularly weak.

> "… We've tried to set up databases that have lessons learned, that have ways to contact subject matter experts in certain areas on various programs, but they all rely on a pull, if you will, from the other program and what you find most of the time is they don't pull. So we've **tried to find ways to push information to programs** when they don't even know to ask questions but I would say that our success on that, I think, is more limited than our success in integrating across functions." (Amy, EQUIP)

Supply Chain Resource Orchestration

The next section provides the main case evidence of suppliers' SCRO practices. Based on the literature, SCRO is a multi-faceted concept and entails three important dimensions of structuring, bundling, and leveraging, but little is known about its specific dimensions. The interviews with

supply chain managers enabled now to obtain further insights into what these managerial activities really mean in practice. How are supply chain managers implementing SCRO? And what practices are managers emphasizing and prioritizing? The interviews revealed that the organizations tend to emphasize the structuring and bundling sub-processes. Several case companies are highly engaged in identifying and integrating external resources. However, the managers were less concerned with strengthening the leveraging sub-process and tended to neglect the commercialization aspects of resource management. In this way, the case study appears to indicate a gap between the theoretically derived objective of fully synchronized orchestration practices and the implementation in practice.

Structuring

Recall that the conceptualization of structuring in the literature includes acquiring, accumulating, and divesting essential supply chain resources from external constituents (Hitt et al., 2011; Sirmon et al., 2011). Interestingly, the supply chain managers from the case companies prioritized some of those structuring sub-processes such as the acquisition and accumulation, which includes the opportunity recognition with the detection of superior new sources (effective supply market scanning). However, the divesture of resources to "clean up" the resource portfolio appears to be of lesser concern. The managers clearly emphasized resource acquisition over resource sale, which is an interesting contrast to the literature.

A noteworthy pattern emerged during the data analysis. In terms of structuring, strong SCRO-practicing firms differed noticeably from organizations with weak SCRO practices. Case companies that excel in structuring have emphasized a continuous scanning and monitoring of market trends outside of their current supply base. Thereby, they enhance awareness of new,

potentially disruptive technologies and can initiate a response early on. They can determine how to best utilize those new technologies or possibly benefit from them.

> "We do the best we can to scan and look for trends" (Hannah, TECH-2)

> "Scanning the world for solutions …, for example, we created an innovation department .. [*to become*] aware of disruptive technologies that would impact our business" (David, EQUIP)

In contrast, firms with weak structuring sub-processes are solely looking at their current supply base. For a number of reasons, they consider the world outside of their supply base as either not relevant or as infeasible to evaluate the implications of those developments.

> "It was not possible so much to look really outside the world of … business companies so much" (Charles, TECH-1)

The main structuring-related categories mentioned in the interviews were scanning the market, developing external interfaces, building trust and partnering relationships, and finally updating the in-house portfolio with externally-acquired technology. In comparison to the bundling and leveraging sub-processes, the case companies showed relatively high agreement upon the main categories of structuring. For example, all managers noted the importance (to a higher or lesser degree) of defining/developing interfaces to the supplier, developing partnerships to build trust between the organizations, or developing effective scanning practices to become aware of new opportunities in the supply market. Some interviewed managers acknowledged the fundamental need for any organization to establish a purchasing strategy and prepare the make or buy decision.

> "You need to define what you want to do and what [*to source*]… first thing is understanding who are those strategic suppliers and why" (David, EQUIP).

Structuring also involves the continuous renewal of the resource portfolio with external input. The purchasing function plays a decisive role in this regard and needs to be attentive to new capabilities that the supply network is offering.

> "Purchasing's main function was [*to monitor*] supplier capability and supplier capacity" (Henk, EQUIP).
>
> "Why are we not tapping into the value that they can bring to the table with those research and development funds as well as the fact that they're a good supplier too?" (Hannah, TECH-2)

To enable such a resource renewal, the focal organizations depends upon effective scanning practices (scanning continuously the supply market for opportunities, as described in the literature (Zsidisin, Hartley, Bernardes, & Saunders, 2015).

> "Scanning the world for solutions. … for example, we created an innovation department … [*to become*] aware of disruptive technologies that would impact our business." (David, EQUIP)
>
> "We do the best we can to scan and look for trends." (Hannah , TECH-2)

Effective structuring entails building trust and nurturing the partnering relationship with suppliers. Treating suppliers in a fair and consistent manner is a necessity for effective supply chain resource orchestration.

> "New viewpoint from a certain set of suppliers to be more partners, to be more collaborative, to understand how you're going to share intellectual property and manage a mutually beneficial type of a program." (Doug, EQUIP)
>
> "It's our job to ensure that we have a robust supply chain and that doesn't just mean ensuring supply. It means that we're partnering with companies … where we can drive the greatest value." (Hannah, TECH-2)
>
> One thing that we never do enough of is communicating and sharing. When there is that communication and sharing of projects, ideas, status, ideas are generated or a-ha moments where you go, "Did you think about…?" or "Did you include…?" So the more communications we can have on some of these activities, the better the connection and integration (Katie, TECH-2)

However, supply chain resource orchestration appears to be still a weak spot in many instances, and its structuring aspect is not well implemented in many organizations yet. Some managers were critical and noted a lack of openness in their organization.

> "When we're making decisions, right now we look at a narrow subset of indicators in which to make that decision but we need to broaden that and look at the value a supplier can bring … Why are we not tapping into the value that they can bring to the table with those research and development funds as well as the fact that they're a good supplier too?" (Hannah, TECH-2).

Thus, opportunities in the supply network are easily overlooked and neglected, which limits the effective utilization of external resources. More effective structuring activities should help organizations to prevent such mishaps. Table 9 explains the criteria for scoring the structuring sub-process for the case companies. The table also exemplifies the characteristics of both low and high structuring scores for the four structuring categories. For the discussion of the remaining SCRO sub-processes (bundling and leveraging) and of innovation and efficiency culture, a similar table will be provided to explain the specific scoring of the interview data.

Table 9
Structuring Criteria

Category	Low = 1	High = 5
Market Scanning	• Little/No systematic scanning processes • Emphasis on existing supply network	• Active scanning to detect new suppliers • Processes to monitor other industries
Developing Interfaces to Suppliers	• Relatively unclear interfaces • Suppliers are "left alone" and suffer from insufficient data • Constraints and requirements are unclear to the supplier	• Clear specification of interfaces • Detailed exchange about requirements • Supplier has timely access to all relevant data • Established liaison process
Trust Building	• Arm's length relationships with suppliers • "Contractual spirit" • Only minimum interaction	• Focal firm provides development support • "Partnering spirit" with mutually shared objectives • Frequent interaction
Updating of Technology	• Little knowledge about supplier technological capabilities • Little/No awareness of recent developments of suppliers • No systematic process to utilize external technology	• Established process to assess supplier capabilities • Systematic use of external expertise • Monitoring of technological readiness and compatibilities of supply base

Based on the assessment of the interviews with the supply chain managers, Table 10 provides an overview of the scores per case for the main structuring categories.

Overall, the interviews revealed a number of different SCRO practices in terms of structuring the resource portfolio. The more effective organizations were able to better understand their external environment and the need to adapt their constrained resource portfolio accordingly. All case companies had established some form of identification and acquisition processes for external resources. However, some organizations such as TECH-1 are only looking within their industry and thereby risk neglecting essential technological developments and trends outside of their common domain. The better structuring practices of TECH-2 and EQUIP were incorporating the scanning of other industries as well. Interestingly, all five case companies prioritized the acquisition of external resources over the divesture of resources.

Bundling

Bundling refers to the integration of external (SC) resources to shape new capabilities (Sirmon et al., 2011). Hence, organizations combine internal and external resources to develop new, competitive capabilities. In the interviews, the supply chain managers emphasized the categories of (internal) coordination and alignment, the integration of external knowledge, and co-location (fostering external integration). However, the interviews revealed a diversity of opinion across the cases. Several companies tend to be constrained by functional silos and thereby overlooking the supply-chain wide implications. Furthermore, the cross-case analysis revealed that some organizations are more adaptive to their environment than others. Thereby, the cases illustrated the context-dependency of resource management practices.

Table 10
Structuring Scores

Category	Case	TECH -1	TECH -2	LOG	AUTO	EQUIP
	Total Score (4-20)	**9**	**18**	**13**	**11**	**13**
	Assessment Summary	Very poor market scanning and little trust-building activities, but medium-level on interface-development and technology updating	Very good scanning initiatives and interface-development; good on building trust and good technology updating practices	Little market scanning and medium-level interface-development, but good trust-building and technology updating practices	Little market scanning and medium-level score on interface-development, trust-building, and technology updating practices	Very good market scanning initiatives but little interface-development; medium-level score on trust-building and technology updating practices
Market Scanning	Score (1-5)	1	5	2	2	5
Developing Interfaces to Suppliers	Score (1-5)	3	5	3	3	2
Trust Building	Score (1-5)	2	4	4	3	3
Updating of In-house Technology	Score (1-5)	3	4	4	3	3

A noticeable pattern relates to the internal alignment. In terms of this sub-process of bundling, TECH-2 and EQUIP demonstrated relatively strong bundling practices which were distinctive from other case companies with relatively weak SCRO practices. For instance, the former companies ensured data availability for other functions and took decisive measures in enhancing transparency and cross-functional communication. Consequently, internal functions utilize the same data, are well-informed and consistent in their decision-making. Those efforts to align internal departments and functions are illustrative of strong bundling practices.

> [*We*] "would be making information available to people in the NPI process that know nothing about logistics in a form that's consumable for them and they can apply it to their particular program." (David, EQUIP)
>
> "We really heavily rely on and communicate back with our core procurement team to make sure that we're aligned in the steps that we're taking" (Hannah, TECH-2)

In contrast, the AUTO and TECH-1 case companies, for example, showed weaknesses in this regard and relatively little internal alignment.

> "Everybody looks for their own and is not looking left and right" (Kurt, TECH-1)
>
> "That's a problem. Often, sometimes I find that R&D has stepped down the road and done some work ahead of time [*without consulting other functions*]" (Thomas, AUTO)

Nonetheless, most managers strongly argued for the need to achieve both internal, cross-functional and cross-program integration on one hand and strong external integration with the suppliers on the other hand. The supply chain managers emphasized the necessity to coordinate between internal NPD activities and the external suppliers, to facilitate internal cross-functional alignment and communication (speaking with one voice to the supplier), utilizing co-location opportunities, and fostering knowledge enrichment and integration, for example. An essential aspect of bundling relates to enriching in-house capabilities by using external knowledge. This was particularly evident in the cases of LOG, AUTO, and EQUIP.

> [*We*] "say, 'At this point, help us design it. What materials do we use? Do you have any more technologies that we're not aware of? How would you make this happen?' and in some cases, we pull in maybe more than one supplier." (Thomas, LOG)
>
> Quite often, even today, it's really not uncommon where you're developing a product and you will use another company to help you enable that product. (Rodney, AUTO)
>
> "In the electronics area where they knew that we didn't have the technical subject matter expertise and depth that our suppliers did, so how do we work with them to help innovative?" (David, EQUIP)
>
> "As they started to realize that there's a very effective supply base out there that can look at and use technology and knowledge that they have gained through their business and apply that … we started to do more effective supplier integration in the design process." (David, EQUIP)

In the case of TECH-2 from a high-technology industry environment, one manager described the criticality of coordinating the internal and external activities within new product development.

> "We coordinate with the engineering team to understand and create a collaboration plan of what that new technology might look like and who the potential suppliers might be and then develop a list and work through collaboration agreements with the suppliers and then we coordinate with our core organizations, which are the ones responsible for doing the production programs right now. Make sure that they're understanding the business applications or implications those agreements might have and coordinate between the cores, the engineering, and our product development supply management group to align and integrate our strategy and establish and execute the agreement. … We have a collaboration organization that we work with to identify potential projects and project manage some of the activities. Then they coordinate between the engineers and our supply management product development team. … they're focused and coordinate and integrate with the other organizations with the marketing and some of the programs, but for the most part, they interface with the engineering team. They do the project management and they interface with our teams for the agreements in helping to facilitate and, in some cases, negotiate those agreements." (Katie, TECH-2)

Similarly, several managers from another large high-technology company describe the coordination and integration aspects of the resource bundling practices in his environment.

> "We have to coordinate between our suppliers. I mean, a simple example is the interfaces, the physical interfaces of the [product] structure have to match later on. They have to fit. Of course, also the electronic and IT computer interface have to work. So all that has to be harmonized." (Charles, TECH-1)

> "We have those integration meetings and then everybody has to come on the same level and in the end, we have to put out a good product." (Kurt, TECH-1)

> "The only way of doing it is to work a lot closer with the suppliers but in the technical way, not in our commercial perspective. … We really have face to face meetings all the time, continuously, so they always can see what issue could come up." (Jim, TECH-1)

In both technology case companies, managers strongly emphasized the need to remain accountable and honor commitments. Those principles remain essential for sides, the focal

organization as well as the suppliers. This should enable the necessary fairness in dealing across organizational boundaries.

> "We internally work too slow sometimes to solve problems and it is unfair towards the suppliers but when it comes to developing things, the supplier is always open and the supplier is always continuing even when someone has, for example, difficulty in other programs, which is really really good." (Jim, TECH-1)

> "One of the main tenants in the … principles is you make a commitment and you keep a commitment. It sounds very very simple." (Hannah, TECH-2)

David (EQUIP) remarks on further collaboration opportunities with suppliers in the future.

> "There's an opportunity to do more design collaboration activity so that suppliers could take over some of the core functions of the components that we're using and own that design and we're just applying it to the product." (David, EQUIP)

Hence, strong supply chain resource bundling practices require an emphasis on coordination, collaboration and alignment both among internal functions and across the organizational boundaries with the suppliers. Table 12 summarizes the main bundling scores derived from the interview analysis. Four main categories emerged during the data analysis. This includes the practice of co-location and alignment/coordination as well as integration practices, for example. The scoring criteria for low and high bundling practices are described in Table 11.

To summarize the assessment of bundling practices in the technology equipment industry: While all companies exercised integration both across and within organizations, the balance between internal and external integration appears to differ. The use of co-location of supplier representatives physically residing on the customer premises can be interpreted as a substantial investment in external integration.

Table 11
Bundling Criteria

Category	Low = 1	High = 5
External Coordination	• Little/ No coordination between focal firm and suppliers' processes • No procedures to coordinate workflows/actions and schedules	• Strong coordination between focal firm and suppliers' processes • Established procedures to coordinate workflows/actions and schedules • Synchronized activities between focal firm and suppliers
Internal Alignment	• Functional silos • Little internal communication among departments/functions • No central platform to share data internally (functions suffer from data inconsistencies or incomplete data)	• Internal data sharing (e.g. central information platform for other functions) • Cross-functional alignment and joint decision-making toward suppliers (one voice to the supplier) • Frequent communication
Integration of Knowledge	• Little/No collaboration with suppliers on technical level • Neglect of suppliers' knowledge • Little/No learning from suppliers	• Close in-depth collaboration with suppliers on technical level • Processes to effectively utilize suppliers' knowledge • Systematic learning from suppliers
Co-Location	• No ongoing physical presence of suppliers' staff members • Use of only (temporary) business travel	• Suppliers send staff to focal firm (ongoing continuous presence) • Supplier's engineers are physically on-site and integrated in development teams

Table 12
Bundling Scores

Category	Case	TECH -1	TECH -2	LOG	AUTO	EQUIP
	Total Score (4-20)	**12**	**15**	**16**	**9**	**15**
	Assessment Summary	Only little coordination and internal alignment, but good knowledge integration and co-location practices	Good coordination and internal alignment and even very good co-location; however, only little knowledge integration practices	Good coordination and knowledge integration; medium-level internal alignment practices, and very good co-location practices	Only little coordination and poor internal alignment; however, medium-level knowledge integration and co-location practices	Medium-level coordination but good internal alignment, knowledge integration, and co-location practices
External Coordination	Score (1-5)	2	4	4	2	3
Internal Alignment	Score (1-5)	2	4	3	1	4
Integration of External Knowledge	Score (1-5)	4	2	4	3	4
Co-Location	Score (1-5)	4	5	5	3	4

Overall, LOG showed a very strong attention to external integration while AUTO demonstrated only a medium emphasis in this regard. One explanation might be that AUTO is the only case company in a Tier-1 position compared to the other case companies who are the OEM's in their supply chain. Hence, AUTO is frequently dealing with rather medium-sized Tier-2 suppliers that don't have sufficient resources to send company representatives to their customer AUTO.

As the case study revealed, the bundling practices are context-dependent. In many markets, the OEM is the most powerful player in the supply chain. However, in other environments, either downstream distribution (e.g., retailers) or upstream supply chain partners (e.g., key suppliers with valuable external resources) can exercise more power and thereby determine and influence the appropriate mix of bundling practices. Successful external integration requires the attention and commitment of both sides. Accordingly, external integration efforts of bundling are influenced by environmental factors. Similarly, the internal bundling practices of coordination were prioritized by AERO-2, LOG, and EQUIP due to a

number of influences, which might not be sufficiently understood at this time. This case analysis indicated some gaps and suggestions for future research. Possibly, the current resource orchestration literature needs to differentiate in more depth in terms of what particular bundling activities need to be emphasized in which particular environment. So far, the general guideline of synchronizing bundling with the other two sub-processes might not yet be detailed enough in specific circumstances.

Leveraging

One interesting finding is an apparent neglect of leveraging. In contrast to the emphasis placed upon structuring and bundling activities, the interview participants did not focus very much on leveraging practices. In particular, the commercialization aspects appear neglected. At least, customer orientation was considered as essential. The three most important leveraging categories were the capturing of customer needs, the management of the interface to the customer, and the commercialization of the new product or service. Overall, all five cases were relatively poor in terms of leveraging performance, when compared to structuring and bundling. Nonetheless, there are still noticeable differences between the cases in terms of leveraging.

The AUTO case company distinctively showed relatively strong leveraging practices. Several managers emphasized the need to consider the commercialization opportunities of the newly developed goods and services. They were attentive to seasonality constraints and time windows not to jeopardize a commercialization opportunity.

> "… eventually getting purchase orders. That's the final result that we're looking for" (Brandon, AUTO)

> "The bad side is you could spend a lot of time developing something and they'll never order it. So that could be a customer risk there." (Rodney, AUTO)
>
> "A lot of our stuff is seasonal and so for new equipment, it's kind of … If you don't get it by a certain date, then the next model year, you can't get on that one. It has to wait for the next year" (Brandon, AUTO)

However, interview participants from other companies were noticeably silent about this aspect of leveraging. This difference among the case companies was interesting to observe. When comparing the cases, TECH-1 and AUTO are relatively strong in their leveraging practices (scoring 11 and 12) compared to the other three cases (scoring 5, 8, and 9) (Table 10). This observation is in stark contrast to the assessment of structuring and bundling where TECH-1 and AUTO exhibited relatively weak practices and were lagging behind the other three organizations. Hence, within the three sub-processes of SCRO, the leveraging sub-process appears to have unique characteristics compared to the other two.

The following Table 13 illustrates the criteria how the three categories were scored and provides examples of low and high score characteristics of leveraging in the case companies. The leveraging scores for each category are summarized in Table 14 and an assessment summary is provided for each case company.

Innovation Culture

Time and again during the interviews, the supply chain managers referred to different aspects of innovation culture as an impactful factor when developing products and services with supplier input. Based on the case analysis, different facets of innovation culture appear to influence the supply chain resource orchestration framework. The main categories in terms of innovation culture, which emerged from the case study, will be introduced in this section.

Table 13
Leveraging Criteria

Category	Low = 1	High = 5
Capturing Customer Needs	• Little/No attention to customer needs and customer requirements • No systematic process to verify/ensure that customer requirements are met	• High attention to customer needs and customer requirements • Systematic process to verify/ensure that customer requirements are met • Informing customers continuously or bringing them onboard for milestones
Managing the Customer Interface	• Rare/infrequent information exchange and communication with customers • No process to obtain feedback from customers	• Regular information exchange and communication with customers • Requesting feedback from customers
Commercialization	• Little emphasis on Commercialization • Little/No awareness whether customer intends to purchase eventually • Little/No consideration of customers' potential time windows (seasonality) or after market implications	• Emphasis on receiving a purchase order from customers • Ensuring that solutions are affordable and appropriate for customers (meeting their needs) • Meeting time windows of customers for their markets (e.g., seasonality) • Consideration of after-market (spare parts)

Table 14
Leveraging Scores

Category	Case	TECH-1	TECH -2	LOG	AUTO	EQUIP
	Total Score (4-20)	**11**	**8**	**5**	**12**	**9**
	Assessment Summary	Good customer needs management and customer interface management, but medium-level commercialization	Only little customer needs management; medium-level customer interface management and commercialization	Only little customer needs management and customer interface management, and very poor commercialization practices	Good customer needs management, customer interface management, and commercialization	Medium-level customer needs management, good customer interface management, but poor commercialization
Capturing Customer Needs	Score (1-5)	4	2	2	4	3
Managing the Customer Interface	Score (1-5)	4	3	2	4	4
Commercialization	Score (1-5)	3	3	1	4	2

In particular, the supply chain managers appear to agree on four critical categories, which all of them highlighted. Those key innovation culture categories are proactive mindset, holistic thinking (end to end), creativity, and customer orientation. For example, one manager criticized too much short-term thinking or short sidedness, which is limiting the necessary holistic or end-to-end thinking and narrows the decision-making options.

> "If you do not innovate in your program, you lose a huge opportunity." (Benjamin, TECH-1)

> "So when you set the priorities like that, you cause the functions to focus on achievement, achievement, achievement, and not, let's say, on opening their minds, on End-To-End Thinking, which is at the end, the main driver for cost issues." (Benjamin, TECH-1)

According to TECH-2, the supply base needs to be developed and shaped to support innovation for the focal organization.

> [*We*] "actually developed an alternative supply base of suppliers that we want to actually grow because they do have good quality. They are cooperative and they can provide other benefits." (Hannah, TECH-2)

The case companies differed in their extent of innovation culture, as noticeable in terms of the four main categories displayed in Table 12. For example, TECH-1 showed a clear emphasis on creativity. Several interview participants maintained the need to challenge the established procedures and processes while thinking more "outside of the box." Within TECH-1, managers appear to encourage brainstorming and provide a climate of acceptance for new ideas.

> "[*It's critical*] to think different, to challenge again the good old processes, for sure. I would say it is quite good in our culture. It is a key success factor." (Benjamin, TECH-1)

In contrast to the TECH-1 case, David from EQUIP had observed a lack of creativity. He noted inflexibility and relatively rigid structures that constrain the generation of creative new ideas from within the organization.

> "Need to be a little bit more free-flowing and create more of a brainstorming flexible type of an environment." (David, EQUIP)

Some managers emphasized the need to provide autonomy to the new product development team, and empower their members. For example, TECH-2 wants to empower their procurement agents.

> "You need to think about where there are opportunities to let it be a little bit freer and less governance." (David, EQUIP)

> "If we want to produce flexibility, the ability to change the industrial setup. Then you need to give more power and more levers to supply chain from the beginning." (Benjamin, TECH-1)
>
> "You need to leave a bit of air to breathe to the different functions. If you pressurize them like hell, yeah, under pressure, people narrow their mind and are more in reactive mode." (Benjamin, TECH-1)

A striking similarity across all case companies was that managers emphasized the need for some form of customer orientation.

> "The customer is the main driver." (Jim, TECH-1)
>
> "Make sure that we're capturing the customer's perspective. We're looking at it from a life cycle perspective, from the existing customer to the end customer. So we need to look at what the existing customer is experiencing with their equipment ...., and then incorporating those activities back into the product development to see how we can make it better." (Katie, TECH-2)
>
> "One influence is from marketing when there is an unmet need on the market. So our customers are looking for something and usually we develop it, where there's a gap." (Hunter, LOG)
>
> "In the project development itself, you're obviously going to involve sales and marketing because they're the ones that help define the product that you're looking for." (Brandon, AUTO)
>
> "People want to buy the new and fresh product. I think we're moving toward shortening times between life cycles, but the hindrance to that is you have to balance that against the investment of new tooling." (Henk, EQUIP)

Finally, several firms are fostering cross-functional and cross-organizational collaboration in order to jointly develop and plan the innovation activities with the suppliers. Some have formalized those activities and periodically host a supplier day:

> "We coordinate with the engineering team to understand and create a collaboration plan of what that new technology might look like and who the potential suppliers might be and then develop a list and work through collaboration agreements with the suppliers and then we coordinate with our core organization." (Katie, TECH-2)
>
> "What we call a supplier day, we actually sell the project to the suppliers. So we take our preferred supply base. … We kind of tell them the whole story. … we explain what the benefits are, and we get their buy-in at that point." (Thomas, LOG)
>
> "We had a supplier day … where we invited all of our key suppliers that we considered to be our partners, our largest suppliers [*to discuss NPD*]." (Tracy, AUTO)

In terms of the proactivity category, LOG demonstrated a high forward looking approach while AUTO and EQUIP appear to act more in a reactive than proactive mode. The criteria for scoring innovation culture are described in the following Table 15. Subsequently, Table 16 depicts the innovation culture scores for each category.

Efficiency Culture

Very distinct from the prior innovation culture, some organizations emphasized an efficiency culture with an emphasis on cost savings and productivity. Some of the different categories that surfaced during the interviews include an emphasis on detailed cost analysis (cost transparency), clear governance structure, limited autonomy, and process formalization. The case companies exhibited a diverse spectrum of attitudes in terms of efficiency culture. On one hand, AUTO managers revealed a strong cost-focus. Several participants noted consistently strong efforts to reduce costs throughout the organization.

> "A good amount of what we are focusing on here is reducing costs in current products. … we also all know that we're being driven by cost savings." (Tracy, AUTO)

Table 15
Innovation Culture Criteria

Category	Low = 1	High = 5
Proactivity	• Reactive mode (only responding to competitors' actions) • Rigid procedures with little flexibility (George & Marino, 2011)	• Anticipatory mode (being ahead of competition) • Alert to environmental changes and new industry trends • Being prepared to adapt quickly to market changes
Creativity	• Failure avoidance (incentives to minimize mistakes) • "Play it safe" emphasis • Reliance on established approaches • Focus on repeatable processes and established routine • Emphasis on standard operating procedures • (Lonial & Carter, 2015)	• Receptive to new ideas • Seeking novel approaches • Exploring new opportunities • Willingness to accept failures from time to time • Desire to experiment and pioneer • (Kristal et al., 2010; Lonial & Carter, 2015)
Customer Orientation	• Emphasis on internal capabilities and strengths • Process-oriented	• Customer needs are first • Observing market trends
Autonomy / Em-powerment	• Top-down decision making • Clear centralized structure	• Empowerment at local level • Delegated decision-making • Open communication • Regional or sub-unit autonomy (decentralized structure) (Hook et al., 2015)

Table 16
Innovation Culture Scores

Category	Case	TECH -1	TECH -2	LOG	AUTO	EQUIP
	Total Score (4-20)	**16**	**15**	**14**	**9**	**10**
	Assessment Summary	Medium-level proactivity, very good in terms of creativity and customer orientation, medium-level in terms of autonomy	Medium-level proactivity, good on creativity, very good customer orientation, medium-level in terms of autonomy	Good proactivity, medium on creativity, good customer orientation, medium-level in terms of autonomy	Very poor in terms of proactivity and autonomy, medium on creativity, but good customer orientation	Poor in terms of proactivity and creativity, medium-level in terms of customer orientation and autonomy
Proactivity	Score (1-5)	3	3	4	1	2
Creativity	Score (1-5)	5	4	3	3	2
Customer orientation	Score (1-5)	5	5	4	4	3
Autonomy / Empowerment	Score (1-5)	3	3	3	1	3

On the other hand, Benjamin from TECH-1 was relatively frank in his assessment. He observed that his organization has little transparency of actual supply chain-induced costs.

> "We don't have no clue about our [*SC-induced*] costs." (Benjamin, TECH-1)

Overall, both high technology case companies did not exhibit a strong efficiency culture. Some supply chain managers observed a lack of cost transparency as a substantial weakness of the organization. For example, one manager from EQUIP highlighted the need for more cost transparency.

> "People don't know where the cost is outside of whatever they perceive to be the initial product cost. That's where the NPI groups have been focused. That's where design engineering is focused. It's actual product cost." (David, EQUIP)

Later, he elaborated in more detail concerning a lack of cost transparency or cost data sharing between supply chain partners, which limits supply chain-wide coordination and the understanding of up- or downstream implications:

> "There's no cost transparency for either the supplier or the customer and without that cost transparency, it's difficult to really think about it from an end to end perspective. … that cost transparency issue creates a barrier for that end to end thinking because traditionally the customer is not wanting to expose that cost to the supplier." (David, EQUIP)

He noticed a lack of total supply chain cost transparency in this regard:

> "In most cases, design engineers in the early stages of producing the product, they're not thinking about total supply chain cost and for us, for our company, that can have a major impact on the total landed cost to the customer." (David, EQUIP)

However, the EQUIP organization showed a particularly high level of efficiency culture, which was evident by a detailed performance management system.

> "We're now shifting into what I'll call pure performance management culture and taking that detail down to the next three levels of information." (David, EQUIP)

In two cases (EQUIP and AUTO), the need for formal procedures including better process formalization (and harmonization) was highlighted:

> "What they're doing right now is formalizing that process because they kind of have a one size fits all for every program and what they found is that you had different NPI program teams interpreting the process differently." (David, EQUIP)
>
> "Harmonized: That wasn't easy to get to but definitely worth it because otherwise, it looked like we had two sets of books. We had one set that some official group was keeping and another set they were paying from the systems of record within the program

> and you never had constructive conversations when one of the sets was put up on the screen" (Amy, EQUIP)
>
> "We come in contact very early on with the finance group to estimate product cost as to make new equipment, capital expenditures, those kinds of things." (Brandon, AUTO)

Both EQUIP and AUTO emphasized the importance of efficiency targets, including the use of Lean and Six Sigma targets. One option was to simplify (reduce complexity of the process).

> "Utilize six sigma tools as much as possible but at the same time realizing that you want it to be a lean type of activity where you have as much of the wasted effort removed. So that's why we look at trying to find ways to improve the efficiency by sharing similar processes across the business units." (Brandon, AUTO)
>
> "Take complexity out. That way you can have repeatability in your processes. … manufacturing should be king because that's where the profit is generated, at the manufacturing level. So you must do everything you can to make everything as easy and painless for the manufacturing organization." (Henk, EQUIP)

Finally, several managers mentioned the necessity to establish a clear structure about what functions are to be involved at certain development stages. While TECH-2 appears satisfied with the current level of structure, the EQUIP case illustrates room for improvement.

> "We have a very structured process that requires engagement and I would say that that process is constantly being improved to be more inclusive of as many functions as possible, from sales and marketing to engineering to aftermarket, supplier management, production engineering." (Hannah, TECH-2)
>
> "Purchasing is inherently involved in the process because you're typically going to need to buy product from suppliers and get it to the plant. So they've always been involved in the process but their involvement was not as structured in terms of when and what type of information was available at the particular time that it was needed." (David, EQUIP)

The scoring criteria for efficiency culture are described in Table 17. To enable the calculation of a consistent total innovation culture score, reverse scoring was applied for efficiency culture. The Table 18 summarizes the efficiency culture scores from each case company.

By triangulating the data from both literature and empirical case interviews (McGrath, 1981), the emergent theoretical framework of SCRO was developed and the constructs, domain, relationships, and predictions were clarified. Thereby, the theoretical framework and the propositions (*logical arguments*) were enriched. This approach enabled to achieve a sufficient level of theoretical saturation —meaning a relatively good match between theory and data. This discussion did not elaborate about the SCRO-to-Performance relationship, as this was not the focus of the research. This research is focusing on theory elaboration of resource orchestration theory to introduce the supply chain resource orchestration framework. The literature has already established that resource orchestration leads to better organizational performance (e.g., Womak et al., 2016).

Implications and Conclusion

This section closes with managerial implications, theoretical contributions, limitations, and a conclusion. The prior section emphasizes the important interplay between organizational culture and managerial SCRO practices, with the former influencing (moderating) innovation performance of the organization. Both the case data as well as relevant literature indicate that supply chain managers can actively influence innovation performance with the interesting caveat that organizational culture can moderate this relationship. Depending on the strategic orientation of the organization, a firm-wide culture emphasizing and embracing innovation-focused behaviors and practices appears as particularly important for innovation performance.

Table 17
Efficiency Culture Criteria

Category	High = 1	Low = 5
Cost Focus	• Detailed cost controlling established • Clear transparency of cost structure Strong cost reduction targets	• No transparency of actual cost structure • Little cost reduction targets
Formalization	• Formal procedures with little leeway • Adherence to standard operating procedures (high hurdles to deviate) • Rigid milestones in development project plan • Extensive governance structure and project measurement established • Detailed business processes and work routines • ISO 9001 certification or similar	• Limited formalization (many informal workflows) • High flexibility to change/adapt procedures if necessary • Limited project management and • No ISO 9001 certification or similar • (Kristal et al., 2010)
Efficiency	• Simplify processes for high repeatability • Engaged with LEAN system • High focus on efficiency and productivity • Detailed productivity measurement system	• No Engaged with LEAN system established • No or little productivity measurement system in place

Table 18
Efficiency Culture Scores

Category	Case	TECH-1	TECH -2	LOG	AUTO	EQUIP
	Total Score (4-20)	**12**	**10**	**6**	**4**	**7**
	Assessment Summary	Very little cost focus, little efficiency emphasis, and medium-level emphasis on formalization	High emphasis on formalization but little cost focus and little emphasis on efficiency	Very high emphasis on formalization and high focus on costs but only medium-level focus on efficiency	Very high emphasis on costs and formalization, and highly emphasizing efficiency	Little total cost focus but high emphasis on formalization and very high focus on efficiency
Cost Focus	Score (1-5)	5	4	2	1	4
Formalization	Score (1-5)	3	2	1	1	2
Efficiency	Score (1-5)	4	4	3	2	1

Generally, this research rebalances the resource management literature by highlighting the critical need for congruence between strategy, managerial practices, and organizational culture. This will be elaborated in more detail in the implications for theory and practice sections.

Managerial Implications

For managers, several interesting observations concern the relationship between managerial decision-making (including strategy), organizational culture, and organizational performance. Figure 5 illustrates the scores in terms of SCRO and innovation culture for all five cases. Ranging in score from 11 to 55, the x-axis provides the SCRO total combining structuring, bundling, and leveraging scores. The y-axis provides the total score of innovation culture (ranging from 8 to 40). The top right box and the lower left box appear to represent a good match between SCRO practices and organizational culture, which will be explained in the following section. In contrast, the top left and lower right boxes appear to indicate a mismatch between supply chain resource orchestration practices and the degree of innovation culture.

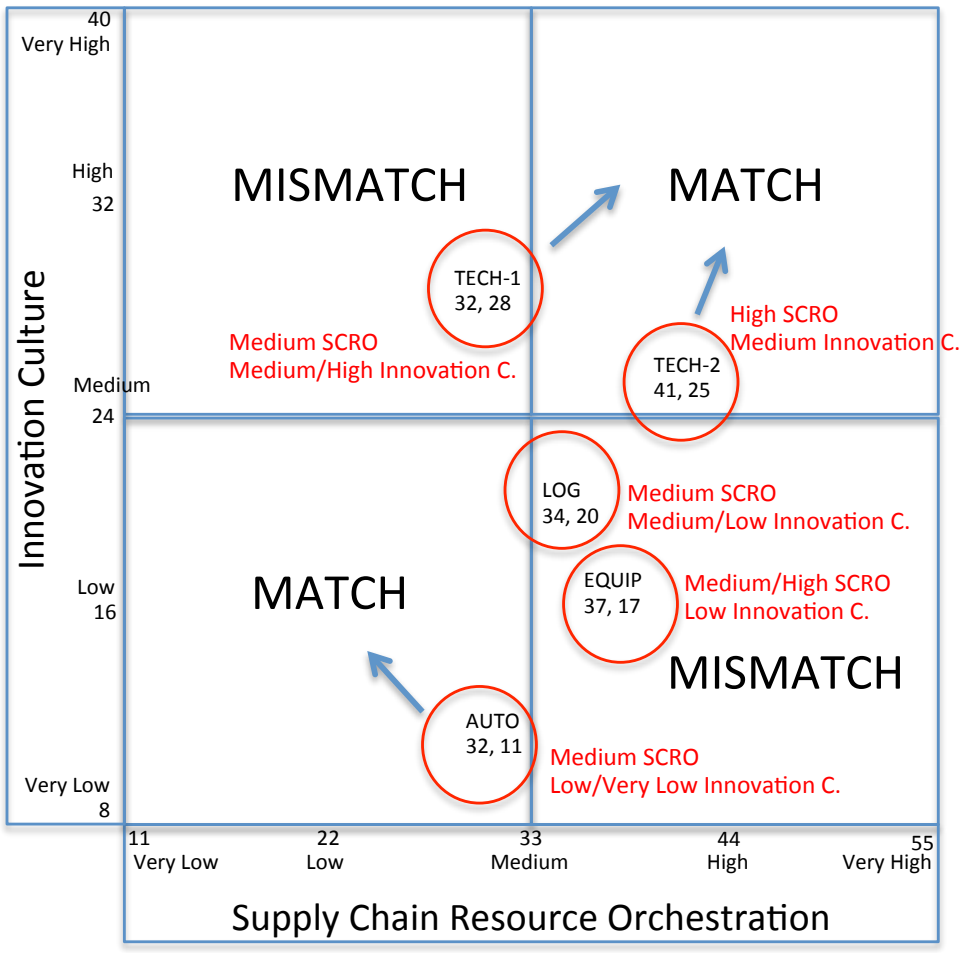

Figure 5 - Interplay between SCRO and Innovation Culture

In this section, the specific managerial implications related to SCRO and organizational culture will be discussed first before concluding with a synthesis and overall summary. Three main implications are:

- Managers need to find the best fit (match) between SCRO practices and innovation (culture)
- Managers need to verify the appropriate level of leveraging practices and address potential gaps
- Managers can utilize the case examples to analyze which specific SCRO practices require fine-tuning or enhancement in their organization

Fit between SCRO and Innovation Culture

The SCRO-Culture matrix illustrates the need to match SCRO practices and innovation culture in the organization. SCRO practices are essential for organizations when striving for higher innovation performance because SCRO facilitates the inflow and integration of essential external resources. However, the appropriate level of organizational culture is decisive and influences the performance impact of SCRO. Overall, TECH-2 appears to have managed a good balance between both SCRO and innovation culture already; the company also showed a good growth (EBIT and revenue). Figure 5 illustrates that TECH-2 should primarily nurture and foster the innovation culture to achieve a "match" position in the upper right quadrant. In contrast, TECH-1 would need to improve in both dimensions, SCRO practices and innovation culture, to reach the "match" position. On the other hand, AUTO has demonstrated a clear cost leadership focus and thereby scored very low on innovation culture. Their medium-level SCRO practices need to be

assessed in detail. Possibly, some structuring or bundling practices (e.g., trust-building or external coordination/alignment) could be scaled down (unless they help to achieve cost targets due to closer integration, for example). For AUTO, less emphasis on SCRO could enable a stable "match" position in the lower left corner.

As noted already in the case overview table, TECH-2 demonstrated the strongest overall SCRO score and showed good growth in terms of profits and revenues (Table 7). Interestingly, the competitor TECH-1 showed the highest score of innovation culture and also the strongest EBIT growth even though its SCRO score was among the lowest of all cases. Clearly, AUTO demonstrated a strong focus on costs and comparatively little emphasis on innovation. From the performance indications, AUTO showed relatively strong EBIT growth and the strongest growth in revenue.

What are the case study's implications in terms of organizational culture? What conclusions can be drawn in terms of strategic orientation? Both TECH-1 and TECH-2 are relatively innovation oriented and, compared to the other three case companies, less focused on costs. One explanation might lie in their market environment. Both organizations are competing directly against each other and split-up the market relatively evenly (about 45% each) with the remainder taken by smaller competitors. Possibly, this market situation facilitates innovativeness.

Due to the large second competitor of equal size, there is little room for complacency because customers can walk away if the value proposition does not fit their expectation (e.g., insufficient innovativeness). Based on a "relatively" established market position (high barriers to entry for competitors), there appears to be less cost-pressure compared to other high technology environments with a higher number of market participants. Thus, both TECH-1 and TECH-2

appear to focus more on a differentiation strategy with continuous innovation than a pure cost leadership strategy. The case of TECH-2 suggests that the link between SCRO and financial performance is more tenuous. The SCRO framework would predict that an organization such as TECH-2 with a relatively high SCRO score should have achieved the highest financial returns but in fact, it did not. TECH-2 demonstrated good financial performance (but not spectacular) during the period of observation. There are two potential explanations. First, a potential time lag between SCRO-related decision-making and the ultimate financial returns might serve as a partial explanation. Second, TECH-2 was particularly weak in terms of leveraging, which should have implications on the financial performance. This would underline again the need to synchronize the practices of all three SCRO sub-processes.

The case companies LOG and EQUIP appear as "stuck in the middle," and might have created confusion within the organization. Both excel neither in terms of innovation nor in SCRO, and the situation appears to reflect a mismatch between SCRO practices, existing culture, and strategic orientation. The financial performance of both companies is mediocre to poor. Hence, the cases would suggest that managers carefully align their level of SCRO activities by either emphasizing innovation objectives (following TECH-2) or focusing on costs (de-emphasizing innovation) following AUTO.

When a company pursues a strong cost leadership strategy, then the bottom right corner might be a recipe for going out of business (e.g., EQUIP with losses) because a high level of SCRO practices might not sufficiently support the cost cutting targets. Analogues to Fisher (1997), a company might need to either strive for high SCRO and high innovative culture score (top right corner) or strive for the bottom left corner (low on both dimensions) to be competitive in the long run. One implication for managers appears to ensure a clear strategic focus and

alignment with the competitive market situation. SCRO activities can work well with either an innovation focus or a cost focus, but management needs to have a distinct strategy in this regard.

Importance of Leveraging

Furthermore, the companies with the strongest scores in the leveraging sub-process (AUTO = 12 and TECH-1 = 11) also showed strong financial performance (AUTO with strongest revenue growth and TECH-1 with strongest EBIT growth). As depicted in Figure 6, no case company scored higher than medium on leveraging. During the interviews, the supply chain managers placed much more emphasis on the structuring and bundling activities. Hence, managers should verify their leveraging practices in their organization and assess whether those need to be intensified. AUTO and TECH-1 are illustrative case example of the potential financial performance benefits. In this case study, TECH-2, LOG, and EQUIP appear out of balance in their approach with more emphasis placed on the structuring and bundling sub-processes. Hence, those companies might benefit from their leveraging practices, the third category of SCRO.

Fine-tune the detailed SCRO practices

A third managerial implication relates to the descriptions of concrete SCRO practices that emerged from the interviews with supply chain managers. In the previous section, the main SCRO practices were illustrated in detail. The tables included in the case analysis section (e.g., Tables 10, 12, and 14) describe the main categories for structuring, bundling, and leveraging practices, for example. Thereby, the tables along with the anecdotal case evidence could serve as helpful guidance for practitioners who want to enhance their understanding of the supply chain

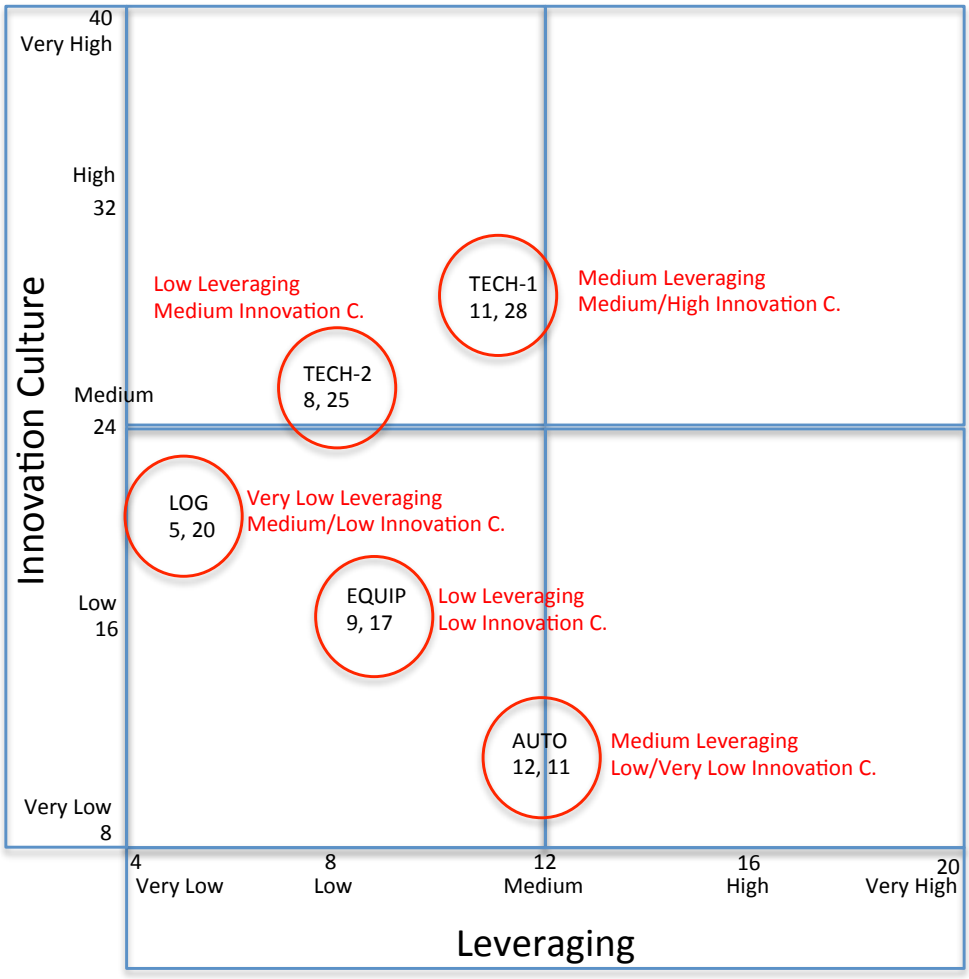

Figure 6 - Leveraging vs. Innovation Culture

resource orchestration phenomenon. Managers can apply best practice learning and fine-tune their SCRO-related procedures in accordance to their strategic objectives and market environment.

To summarize, the case study revealed that successfully innovating organizations are well advised to establish and fine-tune their internal SCRO processes. In a competitive market environment, managers should monitor how effectively their organization is managing the external resource inflow including its acquisition, integration, and exploitation processes. By establishing SCRO practices, organizations can extend their innovation processes and develop new competitive capabilities. Thereby, they can identify, acquire, and integrate external knowledge for the benefit of the organization. The theory elaboration as well as the illustrative case study analysis have both provided detailed information to guide managers in fine-tuning the SCRO practices internally.

Theoretical Contribution

This research study has responded to calls for research to explore and reveal the details of resource orchestration processes (Sirmon et al., 2011). By enhancing the understanding of the managerial practices and micro-processes of supply chain resource orchestration, the SCRO framework extends previous research and refines the theoretical domain of ROT. Overall, the study has added to our understanding of the orchestration of external resources and introduced a new conceptualization of SCRO. The concrete SCRO practices of structuring, bundling, and leveraging were described in detail based both on theory and empirical data. A new perspective related to cross-organizational effects on innovation performance was contributed.

Following the theory elaboration methodology, this research broadens the breadths and depth of the current resource orchestration theory by extending it within the supply chain and open innovation context. The SCRO framework better explains the critical interplay between managerial practices, strategic orientation, and organizational culture. This research serves as an initial step in conceptualizing the SCRO phenomenon and thereby addresses a noticeable gap in the literature. It also proposes directions for future research to enhance the body of knowledge and offers a number of theoretical and managerial implications as contributions to both practice and academic research community. The data triangulation with empirical case study data has enriched the new SCRO framework and contributes as a theoretical contextualization of resource management theories (Craighead, Ketchen, & Cheng, 2016).

The construct of supply chain resource orchestration is introduced as an essential managerial capability for the firm's competitive position. In this research the author has drawn from supply chain, strategic resource management, and entrepreneurship literature streams and applied it to the context of joint innovation practices across supply network partners. Finally, another theoretical contribution concerns the application of the Wacker (1998) components of good theory to analyze resource orchestration theory. The procedures of good theory-elaboration were applied to extend the domain of resource orchestration theory and develop the SCRO framework.

Limitations and Conclusion

The research study has several limitations, which are also opportunities for future research. First, the conclusions might not be generalizable beyond the current research setting of relatively large corporations in a technological market environment. Future research could extend the data

collection and analysis to small and medium sized organizations or even family businesses. Second, the research results are based on a data collection across a two-year time frame and do not consider the impact over a longer period of time. Hence, further longitudinal studies should measure supply chain resource orchestration relationships over more time than two years. In this way, the robustness of the conceptualization could be verified. A follow-up study could include interviews with participants outside of Europe and the U.S. to which the current research was constrained. This would further enhance the generalizability of the findings. Finally, a cross-sectional survey could be used to empirically test the SCRO relationships in future research.

In conclusion, this dissertation research attempts to extend the existing resource orchestration theoretical domain to better address further supply chain and open innovation phenomena. The necessity of better managing supply chain-based resources has been highlighted by both scholars and practitioners, which served as a motivation for this dissertation. Applying a theory elaboration approach in this section resulted in a conceptualization of supply chain resource orchestration, addressing the first research question. The subsequent case study analysis enriched the understanding by adding the perspectives of supply chain managers. Specifically, the interplay between organizational culture and SCRO as well as detailed SCRO practices were introduced and explained, addressing the other two research questions. Finally, this section provided a number of managerial and theoretical implications, noted some limitation of the research, and presented future research opportunities. Overall, supply chain resource orchestration appears to be a promising emerging framework assisting the further development of the field. The next step of the dissertation research is an empirical validation of the framework by using a cross-sectional survey, which will be addressed in the next chapter.

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CHAPTER FOUR – ARTICLE 3: THEORY TESTING

Abstract

In many markets, innovation has become a strategic imperative to ensure competitive survival (Wowak, Craighead, Ketchen, & Hult, 2016). Employing external resources to fill in-house gaps, organizations increasingly initiate and manage joint product or service developments across their supply networks (Rothaermel & Alexandre, 2009). However, little is known about the relevant practices of supply chain resource orchestration (SCRO), which relates to structuring, bundling, and leveraging resources as well as corresponding capabilities derived from external constituents to create customer value. Thus, further scholarly attention should be placed on the SCRO mechanism and its influence on innovation and financial performance (Crook & Esper, 2014; Zimmermann & Foerstl, 2014).

The moderating impact of cultural factors such as a firm-wide entrepreneurial orientation on resource management processes is not well understood yet either (Nakata & Im, 2010; West & Bogers, 2014). This research serves as an initial step in this direction by assessing the performance impact when supply chain managers deliberately orchestrate their supply chain resources. In this study, the emergent resource orchestration theory (Sirmon, Hitt, Ireland, & Gilbert, 2011) and a cross-sectional survey of 247 supply chain managers are applied to test a SCRO conceptualization and verify the moderating influence of entrepreneurial orientation. As a theoretical contribution, a new conceptual framework of SCRO is tested. At a practical level, the research findings guide supply chain managers about the need to synchronize resource structuring, bundling, and leveraging activities while considering the effect of attitudinal factors on innovation and financial performance.

This research investigates three SCRO practices (sub-processes) of structuring, bundling, and leveraging of supply chain resources in detail. Following the methodology suggested by (Li,

Rao, Ragu-Nathan, & Ragu-Nathan, 2005) the conceptualization of SCRO is tested and the measurement scale is validated by utilizing structural equation modeling. This research contributes by confirming the positive contribution of SCRO practices on organizational performance and by providing a measurement instrument for studying managerial practices in the context of supply chain resource management and open innovation.

Introduction

Continuous innovation of its products, services, or processes has become a strategic imperative for most organizations (Linder, Jarvenpaa, & Davenport, 2003) and was identified as the uppermost challenge for organizations today (Wowak et al., 2016). For this research, innovation is defined as "implementing new ideas that create value" (Linder et al., 2003, p. 44). In many industries, at least half of the current revenues depend on newly developed products and services (Cooper & Edgett, 2003; Schilling & Hill, 1998; Visser et al., 2010). Innovation has become a strategic top priority on the corporate level (Heidenreich & Kraemer, 2016; Oke, Prajogo, & Yayaram, 2013; Song & Montoya-Weiss, 2001), and the supply chain function adopted innovation as one of the five main competitive priorities (Krause, Pagell, & Curkovic, 2001). Hence, a critical question for supply chain managers became how to effectively support the organization's innovation and financial performance.

The failure rates of innovation activities are debated in the literature, and may range between 35% and 70% in practice (Castellion & Markham, 2013). Many scholars agree that the risks of new development projects are high. As Figure 7 illustrates, the new product and service innovation process is inherently risky, and relatively high failure rates have been documented in various industries (Wowak et al., 2016). On one hand, many development projects never result in a commercial offering in the market (Heidenreich & Kraemer, 2016; Hu, McNamara, & Piaskowska, 2017). From the few that reach the market, on the other hand, a lot of the newly introduced products fail to succeed financially (Bruce, Daly, & Kahn, 2007; Castellion & Markham, 2013). In response to the substantial risks and costs of innovation, organizations started to share risks and costs with external development partners (Gassmann, Enkel, & Chesbrough, 2010; Rothaermel & Alexandre, 2009).

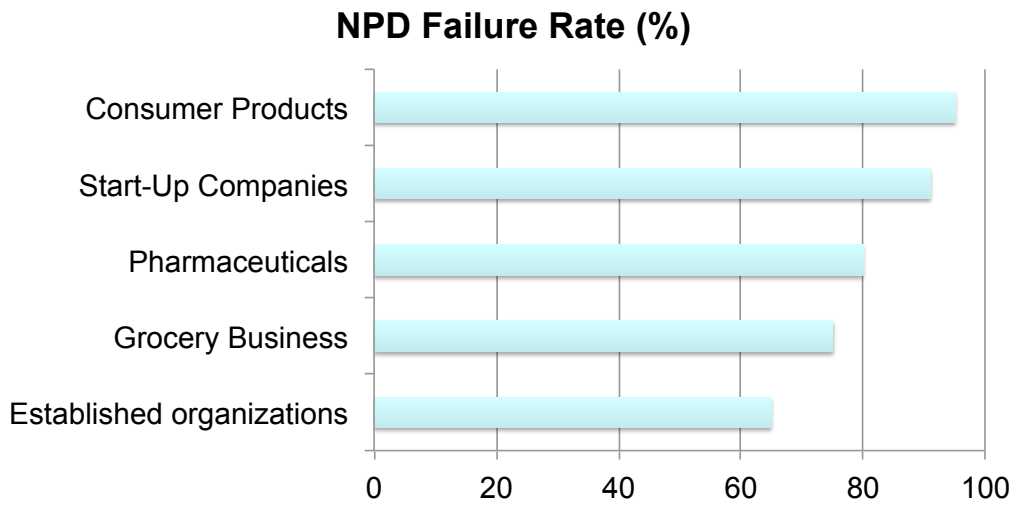

Figure 7 - High Failure Rates of Innovation Activities (Wowak et al., 2016)

This new approach towards innovation has been termed Open Innovation (Chesbrough, 2003) and it encourages joint innovation across organizational boundaries. In this way, creative new ideas from the outside can be utilized, and external knowledge can be leveraged when integrated effectively (Emden, Calantone, & Droge, 2006).

Marketing scholars have intensively studied open and user innovation phenomena already (McNally, Akdeniz, & Calantone, 2011) and investigated co-creation of value with customers, for example (Hoyer, Chandy, Dorotic, Krafft, & Singh, 2010; Nambisan, 2002). However, relatively little research attention has been placed on the supply side of the open innovation phenomena (West & Bogers, 2014). On one hand, traditional supply chain management research has looked at early supplier integration (ESI) (Takeishi, 2001) and the involvement of suppliers in new product development (NPD) projects (Cousins, Handfield, Lawson, & Petersen, 2006; Lawson, Petersen, Cousins, & Handfield, 2009). In this traditional, established framework, the in-house R&D department typically was a driving force for the development, and specific innovative products or solutions were procured to simply complement the internal developmental

efforts (Enkel, Gassmann, & Chesbrough, 2009). On the other hand, however, the locus of innovation has shifted now, within the new innovation paradigm, from individual firms to the network of constituents (Hoopes & Postrel, 1999; Powell, Koput, & Smith-Doerr, 1996). Each member in such a network is sharing knowledge and contributes as developmental partner to the joint innovation success. The previously solid organizational boundaries have evolved into a "membrane" through which knowledge flows in both directions outside-in and inside-out (Gassmann et al., 2010). Hence, scholars have called for more supply management research to better understand the consequences of this important development towards more open innovation (Enkel et al., 2009).

Serving in a boundary-spanning function, supply chain managers appear well positioned to extend their role within the open innovation framework by developing new organizational capabilities to effectively identify, acquire, integrate/coordinate, and leverage this external knowledge for the benefit of the organization (Oke & Kach, 2012). Those activities are aggregated under the concept of supply chain resource orchestration (SCRO). As SCRO is defined and conceptualized in Chapter Three, this chapter will only briefly explain the concept as a starting point for the hypotheses development.

In this research, supply chain resource orchestration is defined as the relevant processes of managing the acquisition, integration, and exploitation of critical external resources. Supply chain resource orchestration is considered as a multi-dimensional concept with the sub-processes of resource structuring, bundling, and leveraging. Surprisingly, even though it might play an important role within the organizational innovation phenomenon, this construct has received relatively little empirical research attention so far. Many papers on resource orchestration have been solely conceptual (Sirmon et al., 2011). Scholars have noticed this gap and called for more

research on supply management processes within the open innovation framework (Gassmann et al., 2010), on practices how to obtain innovative resources from suppliers (Schoenherr et al., 2012), and generally on inter-firm resource management coordination (Arlbjorn & Paulraj, 2013; Crook & Esper, 2014; Dhanaraj & Parkhe, 2006; Stock, Boyer, & Harmon, 2010).

Even though other innovation-related SCM topics have been investigated in depth, this micro-level (operational) practices and capabilities have received little scholarly attention to date capabilities (Baert, Meuleman, Debruyne, & Wright, 2016; Sirmon et al., 2011). There is an apparent need to better understand the operational management of supply chain resources and to gain deeper insights into the relevant managerial practices (Barney, Ketchen, & Wright, 2011; Hitt, 2011; Ketchen, Wowak, & Craighead, 2014), going beyond the organizational boundaries of the firm (Crook & Esper, 2014; Zimmermann & Foerstl, 2014). Hence, the research motivation is to better understand those detailed practices and micro-level processes and their impact on organizational performance (Crook, Jr, Combs, & Todd, 2008; Ndofor, Sirmon, & He, 2011). Anecdotal evidence from a number of interviews with supply chain managers in Chapter Three has confirmed the high relevance of this topic for practitioners. Managers have struggled with managing the interfirm resource flow. For example, one manager was struggling to facilitate the knowledge exchange between partnering organizations in a new product development project:

> "We've tried to set up databases …, but they all rely on a pull, if you will, from the other program and what you find most of the time is they don't pull. So we've tried to find ways to push information to programs when they don't even know to ask questions but I would say that our success on that, I think, is limited"
> (Supply Chain Manager, responsible for joint innovation with suppliers)

Research Motivation

In summary, the research gap described has led to the development of the supply chain resource orchestration framework in Chapter Three. Thereby, it was demonstrated that both researchers and practitioners alike have emphasized the need to establish effective SCRO processes in an organization to enhance organizational performance (refer to Chapter Three). They described the need to balance or synchronize the structuring, bundling, and leveraging practices in the organization.

Thus, the literature indicates a need to better understand the concrete managerial practices: How to manage the resource flow in general, and specifically the inflow of external resources from the supply chain? Furthermore, in Chapters Two and Three, it was noted that the impact of culture matters in the context of innovation (Heidenreich & Kraemer, 2016). The cultural orientation affects the resource management practices and their impact on performance (Oke et al., 2013). Apparently, the influence of attitudinal factors on resource management practices has not yet received sufficient scholarly attention to date so that critical questions remain (Azadegan & Dooley, 2010; De Brentani & Kleinschmidt, 2004).

How is the firm-wide stance toward innovation affecting organizational performance? What is the moderating influence of attitudinal factors on the performance impact of managerial practices? Scholars have noted a need for more research on influence tactics/mechanisms (Engelen & Brettel, 2012) and the impact of culture and strategic orientation on new product development performance (strategic innovation capability) (Nakata & Im, 2010).

Hence, this research will attempt to address this gap and consider cultural effects on resource management practices. In this dissertation research, entrepreneurial orientation is applied as a proxy to measure the attitude or stance toward innovation on the organizational

level. The purpose of this research is to test the conceptual model of SCRO including the moderating influence of EO on the relationship between SCRO and organizational performance. Specifically, the research is intended to assess the interaction effects between SCRO and EO and empirically verify the effects on organizational performance, as conceptualized in Chapter Three. This research takes a firm-level perspective.

There are two main objectives of this research: First, this research is intended to test the critical supply chain resource orchestration mechanism and its impact on organizational performance. Second, the study will analyze the moderating influence of corporate entrepreneurial orientation on the relationship between SCRO and organizational performance. Hence, the research questions for this paper are:

RQ1: How does supply chain resource orchestration influence innovation and financial performance?

RQ2: How does entrepreneurial orientation affect the relationship between supply chain resource orchestration and organizational performance?

The chapter is structured as follows: First, the relevant literature and applicable theory is briefly reviewed. Second, the supply chain resource orchestration framework is introduced, followed by the development of research hypotheses. In the methodology section, the different structural equation modeling steps are described and the results are summarized. Finally, the discussion of theoretical and practical implications, limitations, and future research opportunities will conclude this chapter.

Theoretical Framework and Hypotheses Development

Open Innovation Framework

Researchers have emphasized the need for organizations to utilize externally available knowledge and urged "to take into account the wealth of activity outside the firm" (Chesbrough, 2003, p. 52). With a broader scope and distinct from the early supplier integration concept, open innovation is a new organizational approach toward innovation and creates the opportunity for new business models (Chesbrough, 2006). It is based on a fundamental paradigm shift from a pure internal focus to a holistic perspective on innovation and development activities. Besides, organizations develop an innovation orientation (Oke et al., 2013), as discussed in Chapter Two, and are becoming alert to and receptive for ideas generated outside of the organization (Chesbrough & Crowther, 2006). Fundamentally, open innovation practices are expected to enhance innovation performance (Gassmann et al., 2010).

Following the open innovation framework (Chesbrough, 2003), innovation originates in a joint collaborative network among internal and external participants. Organizations foster and nurture a mutual exchange of ideas and solutions. Knowledge flows more easily between the external environment and the company's internal innovation process" (Gassmann & Enkel, 2004). Joint innovation collaboration, the strategic approach towards open innovation, is essential because of increasing product, service, and process complexity (Iansiti, 1995; Katz & Allen, 1985).

Likewise, innovation performance has evolved into a strategic weapon (Song & Montoya-Weiss, 2001). Hence, open innovation has emerged as an important competitive enabler (Chesbrough, 2006) and a critical driver of growth (Calantone & Di Benedetto, 2012). Managing an effective inter-organizational development project can result in substantially faster

time to market (Di Benedetto, 1999; McNally et al., 2011). By applying the open innovation approach, companies strategically share risks and costs with partnering organizations (Chesbrough & Crowther, 2006).

The diverse terminology related to open innovation and supply management activities necessitates some clarification, especially in regards to innovation outsourcing and innovation sourcing. Innovation outsourcing is based on (product) innovations being fully externally developed, and then implemented or commercialized by the buying organization (Tether & Tajar, 2008). Thus, the locus of innovation resides with an external organization. However, this dissertation research focuses on supply chain resource orchestration, which utilizes innovation sourcing sub-processes. Recall that SCRO is a systematic SCM process of purchasing, integrating, and exploiting key SC resources. The SCRO practices that support innovation utilize an innovation sourcing sub-process within the open innovation context. The procurement of innovative knowledge from external sources is a key mechanism for (internal) resource accumulation (Parmigiani & Rivera-Santos, 2011). However, SCRO is not solely focused on external relationships but requires internal, cross-functional integration as well. Importantly, supply chain resource orchestration is based on both inter-organizational and intra-organizational activities.

Resource Orchestration Theory

For this research, the resource orchestration theory (ROT) (Sirmon et al., 2011) is be applied as a guiding theoretical lens. As explained in Chapter Three, ROT is derived from the resource based theory (RBT) (Barney, 1991) and the dynamic capabilities theory (Teece, Pisano, & Shuen, 1997). According to RBT, the overarching purpose of the organization is to identify the strategic

resources that lead to a sustainable competitive advantage in the marketplace. Such resources need to be valuable, rare, and imperfectly imitable. Additionally, the necessary organization needs to be established or developed to enable the effective resource exploitation (Kozlenkova, Samaha, & Palmatier, 2014). Researchers have empirically verified the impact of resources on organizational performance and thereby validated the claims of RBT, as demonstrated in a seminal meta-analysis (Crook et al., 2008). RBT has been applied in other fields outside of strategic management, especially in the supply chain management literature where it belongs to one of the most frequently utilized theories in the discipline (Defee, Williams, Randall, & Thomas, 2010).

However, researchers have highlighted some limitations of RBT. For instance, RBT has been criticized for emphasizing the resource characteristics necessary to achieve a sustainable competitive advantage while being silent about the actual practices of obtaining those strategic resources (Sirmon, Hitt, & Ireland, 2007; Teece, 2007). Moreover, scholars have noted that the sole possession of resources is less critical than the actual managerial deployment and effective exploitation of resources (Hansen, Perry, & Reese, 2004; Wowak et al., 2016).

Subsequently, the dynamic capabilities theory (Eisenhardt & Martin, 2000; Teece, 2007) emerged to address some of those shortcomings. Dynamic capabilities have been described as organizational and strategic processes aiming at the identification, integration and re-configuration of essential resources (Teece et al., 1997). How is dynamics capability theory related to supply chain resource orchestration and innovation? Establishing effective supply chain resource orchestration practices would enable the focal firm to better adapt when facing dynamic environmental changes and thereby create a temporary competitive advantage (Winter, 2003). In this way, SCRO would play an extended role in the value-creation strategy of an

organization (Wiklund & Shepherd, 2003). As defined above, SCRO involves the identification, acquisition, integration, and re-configuration of resources. Hence, following Teece (1997), such critical supply chain resource orchestration processes could be considered as dynamic capabilities of the organization.

Supply chain resource orchestration (SCRO)

The latest development in terms of resource management theories relates to synchronized resource orchestration practices. The emphasis of resource orchestration lies on acquiring and combining resources to achieve new resource configurations, and on the respective leveraging mechanisms (Chirico, Sirmon, Sciascia, & Mazzola, 2011). By synthesizing the theoretical frameworks of both asset orchestration and resource management, Sirmon et al. (2007, 2011) have developed the new theoretical framework of resource orchestration theory (ROT). By extending the domain of RBT and dynamic capability theory, ROT specifically emphasizes the important managerial role of structuring, bundling, and leveraging the organization's resources (Hitt, 2011). In this way, ROT addresses the main criticism toward RBT and explains the practices how resources can be employed to create customer value and achieve a (temporary) competitive advantage. ROT underlines the criticality of management practices and decision-making.

In the literature, the focus has shifted from the mere possession of resources to the effective orchestration of a firm's key resources (Chirico et al., 2011). Managerial practices, rather than resource characteristics, can lead to superior performance and the realization of a competitive advantage (Hansen et al., 2004; Ketchen et al., 2014). "What a firm *does* with its resources is at least as important as which resources it possesses" (Hansen et al., 2004, p. 1280).

Essential is how resources are deployed, configured, and exploited to enhance the organization's competitive position (Hansen et al., 2004).

The effective coordination of those main three resource orchestration managerial sub-processes (structuring, bundling, and leveraging) is critical for the organization's value-creation performance and the subsequent achievement of a competitive advantage (Sirmon et al., 2011). The synchronization of the firm's resource structuring, bundling, and leveraging activities creates value and enables to achieve a competitive advantage (Wowak et al., 2016).

Scholars have observed that each practice or sub-process is vital, and specifically the synchronization of the three practices could enhance performance (Koufteros, Verghese, & Lucianetti, 2014). Hence, neglecting one sub-process could be very detrimental to the organization. Managers must find the right balance among the three SCRO sub-processes. These three sub-processes of structuring, bundling, and leveraging are extended to the supply chain domain and will be explained next. The following section will introduce the main theoretical constructs that are relevant for the supply chain resource orchestration framework.

(Supply Chain) Resource Structuring is defined as acquiring or divesting resources to shape a resource portfolio (Hitt, Ireland, Sirmon, & Trahms, 2011). Periodically, an organization determines the fundamental delta between available in-house resources and the total resource requirements to meet corporate objectives. When resources are neither readily available nor feasibly developed in-house, they will be acquired from external constituents (Barney, 1986; Dierickx & Cool, 1989). At the same time, organizations will evaluate the utility of existing resources. Thereby, superfluous in-house resources might be divested after being identified as dispensable for future operations. This phenomenon of essential resource structuring activities has received scholarly attention from a number of strategic management researchers who

developed and utilized the concept of resource structuring. Consequently, this research study is based on such prior seminal findings. The main literature definitions of structuring and its sub-processes are summarized in Table 19.

(Supply Chain) Resource Bundling is defined as integrating resources from the supply chain to shape new capabilities that help creating a competitive advantage (Sirmon et al., 2007). Effectively combining the current in-house resources with complementary (external) supply chain resources should result in new competitive resource bundles. By combining complementary resources and capabilities, firms can realize synergies and could gain a competitive advantage (Wang & Zajac, 2007). Table 20 summarizes the bundling-related definitions from the literature.

(Supply Chain) Resource leveraging: This third SCRO sub-process is defined as exploiting the capabilities (that are based on bundles of resources) to create (end) customer value. The reconfiguration of resources and capabilities is the foundation for effective leveraging processes and enables to create customer value in competitive market environments (Winter, 2003). Other researchers have particularly highlighted the necessity to develop a consistent 'vision' or direction for the resource exploitation (Chirico et al., 2011). This aspect is addressed by the mobilizing sub-process (Sirmon et al., 2011). The leveraging-related definitions from the literature are summarized in Table 21.

To summarize the relevant literature to SCRO constructs: The innovation success is dependent on the effective acquisition of essential knowledge from its supply network partners that may provide a diverse set of ideas, expertise, and capabilities (Narasimhan & Narayanan, 2013). This acquisition relates to one of the three sub-processes of SCRO [resource structuring].

Table 19
Definitions of Structuring and its Sub-Processes

Construct	Definition
Structuring	Structuring refers to the management of the resource and capability portfolio within a single firm.
Structuring	Structuring the resource portfolio involves using processes (i.e., acquiring, accumulating, and divesting) to obtain the resources that the firm will use for bundling and leveraging purposes.
Acquiring	Acquiring refers to purchasing resources from strategic factor markets.
Accumulating	The process of developing resources internally.
Divesting	The process of shedding firm-controlled resources.

Source: Barney (1986); Dierickx & Cool (1989); Sirmon et al. (2007); Sirmon et al. (2011); Hitt et al. (2011); Baert et al. (2016)

Table 20
Definitions of Bundling and its Sub-Processes

Construct	Definition
Bundling	Bundling refers to the processes (i.e., stabilizing, enriching, and pioneering) used to integrate resources to form capabilities.
Bundling	Bundling is the process by which capabilities are formed. Resources within the firm's resource portfolio are integrated (i.e., bundled) to create capabilities, with each capability being a unique combination of resources allowing the firm to take specific actions (e.g., marketing, R&D, etc.) that are intended to create value for customers.
Stabilizing	Stabilizing is the process of making minor incremental improvements to existing capabilities.
Stabilizing	The stabilizing bundling process is similar to the concept of coasting. The intent of stabilizing is to make minor incremental improvements in existing capabilities.
Enriching	The process of extending current capabilities; although the degree of enrichment can vary, it extends beyond keeping skills up to date.
Pioneering	The process of creating new capabilities with which to address the firm's competitive context.

Source: Sirmon et al. (2007); Wang & Zajac (2007); Sirmon et al. (2011); Hitt et al. (2011); Baert et al. (2016)

Table 21
Definitions of Leveraging and its Sub-Processes

Construct	Definition
Leveraging	Leveraging involves the set of processes (i.e., mobilizing, coordinating, and deploying) used to exploit capabilities to take advantage of specific markets' opportunities.
Leveraging	Refers to the application of resources and capabilities within a single firm to create value for customers and wealth for owners.
Mobilizing	The process of identifying the capabilities needed to support capability configurations necessary to exploit opportunities in the market.
Mobilizing	A 'vision' or direction for the use of resources is needed for effective leveraging, which is referred to as mobilizing.
Coordinating	The process of integrating identified capabilities into effective yet efficient capability configurations.
Deploying	The process of physically using capability configurations to support a chosen leveraging strategy, which includes the resource advantage strategy, market opportunity strategy, or entrepreneurial strategy.
Deploying	The deploying process involves physically using capability configurations to support the chosen leveraging strategy. The ability of the firm's capabilities to create value for customers is realized through their successful deployment.

Source: Baert et al. (2016); Chirico et al. (2011); Crook et al. (2008); Hitt et al. (2011); Ketchen et al. (2014); Sirmon et al. (2007); Sirmon et al. (2011)

Employing such external yet heterogeneous knowledge base is expected to enhance the innovation capability of the organization. Nevertheless, the process of integrating and absorbing externally acquired knowledge [resource bundling] is a second decisive aspect. This bundling capability of a firm determines the ability to adapt the accessible external information and integrate it to match internal knowledge needs (Azadegan & Dooley, 2010). Finally, the capability for internal exploitation of externally acquired knowledge is the third decisive factor [resource leveraging]. Only the successful commercialization of this newly acquired and integrated knowledge will provide a foundation for innovation and financial performance. Thereby, enhancing information access [resource structuring] from external partners and balancing/connecting it with internal knowledge [resource bundling] to enable the commercialization [resource leveraging] are three critical managerial practices for an organization. All those three sub-processes of SCRO appear to interdependently influence the innovation and financial performance outcome. Following the theory elaboration in Chapter Three and the SCRO explanations in the preceding section, SCRO is expected to influence organizational performance. Especially based on the open innovation framework (Chesbrough, 2003), supply chain resource orchestration processes will enable the organization to tap into the wealth of externally available knowledge. Consequently, SCRO as a new capability of the company should enhance the organization's ability to innovate and result in better market and/or technological innovation achievements. Thereby, both innovation and, ultimately, financial performance should be increased due to SCRO practices. Accordingly, it is hypothesized:

Hypothesis H_{1A}: SCRO is positively associated with innovation performance.

Hypothesis H_{1B}: SCRO is positively associated with financial performance.

Innovation and Financial Performance

In the SCRO framework, innovation and financial performance are the outcome variables at the level of the organization, and will be described in the following section. Innovation performance has been defined in numerous different ways in the literature as explained in Chapter Two. Some researchers have emphasized the degree of commercial success of new products or services, while others focused on the achievement of internal objectives related to product/service quality (Chen & Huang, 2009; Luca & Atuahene-Gima, 2007). In other studies, the performance outcome of innovation activities refers to market (e.g., number of new products or services introduced) or technological (e.g., registered patents or patent citations) achievements (Gupta, Raj, & Wilemon, 1986). In this research, innovation performance is understood relatively broadly so that a combination of the established definitions will be applied.

Innovation performance definitions partially overlap the domain of financial performance constructs as outlined in Chapter Two. Some researchers have used product-level measures (e.g., product profitability) for financial performance (Swink, Talluri, & Pandejpong, 2006). Others have applied firm-level measures such profitability or asset utilization to assess the financial strength of a firm (Leuschner, Carter, Goldsby, & Rogers, 2014). Financial performance (profitability, return on assets, return on investment, etc.) is a frequently applied indicator of organizational performance (Richard, Devinney, Yip, & Johnson, 2009), and will be utilized as a dependent variable in this dissertation research. Firm financial performance is the consequence of sales performance and naturally an antecedent of shareholder economic return, both of which are related constructs of organizational performance (Richard et al., 2009). Recent meta-analysis results have confirmed a significant financial performance impact of resources and resource management (Crook et al., 2008).

Entrepreneurial Orientation

In Chapters Two and Three, it was argued that cultural effects matter in this supply chain-driven innovation context. In this research study, the construct of entrepreneurial orientation (EO) is applied as an existing, well-established construct to test both direct effects and the moderating influence on innovation and financial performance. Researchers have assessed EO as essential for creating a common vision, particularly in regards to successful resource exploitation (Chirico et al., 2011).

Entrepreneurial Orientation (EO) is reflecting the strategic posture towards entrepreneurship and innovation (Anderson, Kreiser, Kuratko, Donald, Hornsby, & Eshima, 2015) and has been defined primarily as innovativeness, proactiveness, and risk taking propensity (Covin & Slevin, 1989; George & Marino, 2011). Researchers have already demonstrated that EO can positively influence the innovation performance of an organization (Patel, Kohtamakl, Parida, & Wincent, 2015).

To build on such prior work, this research study will investigate whether those well-established EO-related research findings would be applicable for the corporate SCM environment. In this study, it will be tested whether EO is moderating the relationship between SCRO and innovation and financial performance. Furthermore, the direct influence on both performance variables will be assessed. An organization with only limited EO levels is hypothesized to achieve only limited innovation performance (possibly only incremental innovation), which is ultimately limiting financial performance as well. This leads to the following hypotheses:

Hypothesis H_{2A}: Entrepreneurial Orientation is positively associated with innovation performance.

Hypothesis H_{2B}: Entrepreneurial Orientation is positively associated with financial performance.

Following the entrepreneurship literature, the EO mindset would also be critical for both innovation and financial performance. The interaction between both constructs appears particularly meaningful. Following the conceptual development of Chapters Three and Four, an organization demonstrating strong entrepreneurial orientation should enhance the performance implications of supply chain resource orchestration in terms of both innovation and financial performance. In contrast, an organization demonstrating only weak entrepreneurial orientation should dampen the performance implications of SCRO in regards to both innovation and financial performance. The moderation effects of EO are hypothesized as follows:

Hypothesis H_{3A}: Entrepreneurial Orientation is positively moderating the relationship of SCRO with innovation performance.

Hypothesis H_{3B}: Entrepreneurial Orientation is positively moderating the relationship of SCRO with financial performance.

In conclusion of the conceptual and hypotheses development, the theoretical framework of supply chain resource orchestration is illustrated in Figure 8.

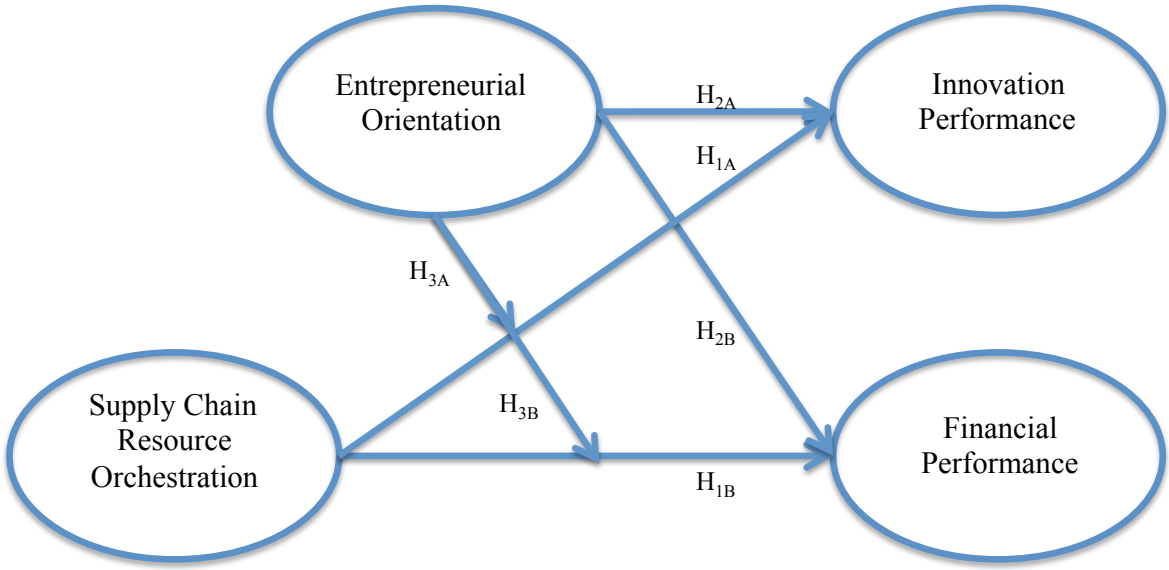

Figure 8 - Conceptual Model of SCRO

Methodology

This research of testing the supply chain resource orchestration framework was conducted in several steps. First, a literature review was performed to understand the current body of literature on this phenomenon. Furthermore, a number of research interviews with supply chain managers were conducted to enhance the understanding of this complex phenomenon. Based on that foundation (literature review and research interviews), a conceptual model of supply chain resource orchestration was developed, as outlined in Chapter Three.

In this chapter, the conceptual SCRO model and the hypotheses are empirically tested. Data for this dissertation study was collected with a cross-sectional and internet-based survey design methodology (Dillman, 2007). The survey method has been used very frequently in supply chain research (Defee et al., 2010) and is appropriate to address this study's research question(s). Advantages of survey designs include the opportunity to collect perceptional

measures from respondents, drawing data from a large population, and relatively low costs compared to some other designs (e.g., experiments). Survey design can capture a large cross-section of the population so that its results enable higher generalizability than other methods (McGrath, 1981). In terms of supply chain resource orchestration and entrepreneurial orientation, the collection of perceptional data appears advisable, because neither SCRO nor EO could be captured directly.

Furthermore, a survey might be the best approach to collect perceptional innovation performance data for industries where frequently used proxies such as patent registrations or patent citations are not available (Marsh & Stock, 2006). Specifically, the survey allowed collecting data from practitioners employed in the service industry, which has been researched to a lesser extent than traditional product-based industry in terms of innovation.

Structural Equation Modeling Method

With the structural equation modeling (SEM) technique, both a measurement model (confirmatory factor analysis FFA) and a structural model (path analysis) are developed and tested. SEM allows conducting both analyses in a combined way. A measurement model is critical to assess how well the observed measurement items (indicators) serve as a measurement instrument for the latent constructs/variables. As a major advantage, structural equation modeling is able to account for measurement error in the latent variables when estimating the path relationships between the factors, and in assessing all relationships simultaneously (not sequentially as in regression analysis) (Hair, Black, Babin, & Anderson, 2010).

Exploratory Factor Analysis

Some researchers have recommended doing an EFA as an initial step of measurement model analysis when using measurement items in a new context. As there are no established and verified scales available for SCRO, an exploratory factor analysis (EFA), which is an unguided method, was conducted in SPSS. EFA assists in indicating how many factors are necessary to explain the relationships among a set of indicators with estimation of factor loadings. Thus, an exploratory factor analysis (EFA) was performed for supply chain resource orchestration and entrepreneurial orientation. The initial model with all items was analyzed (KMO test was significant, the lowest communalities were checked. The Eigenvalue = 1 was used as a cut-off criterion. However, a number of cross-loadings were noticeable. Step-by-step, the individual items were removed to eliminate the problem of cross-loaders (the item with the lowest communality was chosen for the next removal step) until all cross-loadings were eliminated. The EFA results were then used for the subsequent confirmatory factor analysis that will be described later in this section.

Survey Instrument Development

The survey questions are based on the existing literature. Following other researchers, a detailed survey pre-test with supply chain management scholars and practitioners was performed to verify the questionnaire beforehand and clarify potentially ambiguous questions (Dillman, 2007). The questionnaire was reviewed by eleven supply chain, marketing, and entrepreneurship scholars and a number of practitioners from the author's former employer. They were asked to read through the questionnaire and provide feedback whether the questions were clear, understandable (Lindell & Whitney, 2001). They also commented on the survey length (Dillman, 2007). Due to

their feedback, the attention checks and marker variables were slightly adjusted to ensure a better question flow. Two questions (intended as marker variables) were dropped because it appeared too obvious to the reviewers as insufficiently related to the study focus. Hence, the pre-testers highlighted this as problematic and even possibly annoying for the respondents. The wording of some questions was refined to eliminate any ambiguity as much as possible (Schwarz, 1999). Based on this review process, the final survey included some relatively minor adaptions and rephrasing of questions to eliminate potential ambiguities.

Measurement Items

Existing scales were used as much as feasible. The survey was administered using panel data from Qualtrics. To better understand boundary conditions of the particular setting, several control variables were included. With the exception of the SCRO construct, existing measurement scales could be used for this survey research and adapted if necessary. The advantage was that those existing scales were previously tested and validated already. Hence, current scales for entrepreneurial orientation, innovation performance, and financial performance were utilized. However, there is no available scale for either resource orchestration or supply chain resource orchestration practices available yet.

So far, other researchers have operationalized related constructs such as resource integration practices, sourcing processes, SCM practices, or orchestration practices, etc. (Li et al., 2005; Vanpoucke, Vereecke, & Wetzels, 2014) which served as a foundation. Hence, particular effort was placed on item generation, scale development, and construct validation (Hinkin, 1995; deVellis, 2003; Hair et al., 2010).

As recommended by other researchers (Hinkin, 1995), a consistent 7-point Likert-type scale with the end points of ‘‘strongly disagree’’ and ‘‘strongly agree’’ was applied for measuring both the predictors (SCRO and EO) and the outcome variables (innovation and financial performance). The next section will include the pre-testing and pilot testing of the survey instrument, and a description of the detailed steps conducted to verify the construct validity of all items.

Supply Chain Resource Orchestration

The SCRO items were developed on the basis of the emerging resource orchestration research stream (Sirmon et al., 2011) as well as the research interviews with practitioners from various industries and firm sizes (Table 22). The literature definitions of SCRO and its three sub-processes were already depicted in the prior Tables 19-21. All the three main sub-processes of resource structuring, bundling, and leveraging are addressed with multiple scale items to enhance the reliability (DeVellis, 2003; Hinkin, 1995). The following tables summarize the measurement items for SCRO, EO, and both performance constructs.

Entrepreneurial Orientation

To operationalize the entrepreneurial orientation construct, existing scales were used (Rauch et al., 2009) and adapted as needed (Table 23). For this dissertation research, eleven relevant papers that used the EO construct either as independent or moderating variables were analyzed in terms of the entrepreneurial orientation scale applied. All of those research projects considered EO as a firm-level construct. Those studies have typically utilized a single respondent (e.g., a member of the top management team) to determine this firm-level orientation. To measure the dimensions of entrepreneurial orientation, some researchers have applied three firm-level components, namely

Table 22
Measurement Items of SCRO

Construct	Item Text
Structuring	My organization … … Obtains externally available know how from the supply chain to complement existing capabilities … Invests in innovative technology developed by external companies from the supply chain … Renews its in-house process capabilities by adding expertise from suppliers … Updates the in-house technology with supply chain input … Captures knowledge from the supply chain
Bundling	My organization … … Recombines external knowledge to create new organizational know how … Converts external knowledge into in-house capabilities … Synchronizes internal with external innovation activities
Leveraging	My organization … … Coordinates the product /service development activities with members of our supply chain ... Creates liaison position(s) to facilitate the information flow with our suppliers … Uses colocation between in-house experts and external development partners from the supply chain ... Emphasizes joint decision-making with key suppliers involved in NPD … Utilizes development capabilities to take advantage of market opportunities … Offers innovative solutions to customers based on joint development with members of the supply chain … Deploys supply chain resources to create customer value in the marketplace

Source: Adapted from Hitt et al. (2011); Li et al. (2005); Sirmon et al. (2007, 2011); Vanpoucke et al. (2014); Wowak et al. (2016)

Table 23
Measurement Items of EO

Construct	Item Text
Autonomy	In general, top managers of my organization believe that … … The best results occur when individuals and/or teams decide for themselves what business opportunities to pursue My organization … … Supports the efforts of individuals and/or teams that work autonomously In my organization … … Employee initiatives play a major role in selecting the innovation opportunities my firm pursues
Competitive Aggressiveness	In dealing with its competitors, my organization ... … Adopts a very competitive "undo-the-competitors" posture … Acts very aggressive and intensely competitive
Proactive-Innovativeness	In dealing with its competitors, my organization ... … Initiates actions which competitors then respond to … Is the first business to introduce new products/services, administrative techniques, operating technologies, etc. Changes in product or service line have usually been quite dramatic
Risk-Taking	In general, top managers of my organization have ... … A strong inclination for high risk projects (with chances of very high returns) In general, top managers of my organization believe that ... … Bold wide-ranging acts are necessary to achieve the firm's objectives

Source: Adapted from Miller & Corvin (1989); Slevin (1989); Lumpkin & Dess (1996); Hughes & Morgan (2007); Rauch et al. (2009); Covin & Wales (2012)

innovativeness (creativity and pioneering), risk taking (propensity to take risks), and proactiveness (anticipation) derived from the EO conceptualization of Miller (1993). Researchers have defined innovativeness as the "capability to develop and introduce new products or processes" (Azadegan & Dooley, 2010, p. 489). Innovativeness has been also described as a firm-level capability that includes being receptive to new ideas, products, or processes, and fostering their implementation or adoption (Droge, Calantone, & Harmancioglu, 2008). Risk taking has been described as "taking bold actions by venturing into the unknown, borrowing heavily, and/or committing significant resources to ventures in uncertain environments." (Rauch, Wiklund, & Frese, 2009, p. 763). Finally, the construct of proactiveness has been defined as "an opportunity-seeking, forward-looking perspective characterized by the introduction of new products and services ahead of the competition and acting in anticipation of future demand." (Rauch et al., 2009, p. 763).

The traditional 3-dimensional Miller scale has been used repeatedly in prior innovation-related research (Cao, Simsek, & Jansen, 2015; Rauch et al., 2009; Wiklund, Davidsson, Audretsch, & Karlsson, 2011; Wiklund & Shepherd, 2003). Other researchers have added the dimensions of autonomy and competitive aggressiveness to the EO scale (Rauch et al., 2009). Competitive aggressiveness refers to the intensity of an organization to outperform its competition and some key attributes are a robust and offensive stance or aggressive actions toward rivals in the market place (Lumpkin & Dess, 1996; Rauch et al., 2009; Rosenbusch, Rauch, & Bausch, 2013).

Autonomy is related to independent decision-making and implementation of new ideas by management or organizational groups (Cao et al., 2015; Covin & Slevin, 1989; Rauch et al., 2009). Some scholars have also suggested to treat EO not as an aggregated construct, but as a

multidimensional construct to better understand the relationships of the underlying dimensions (Miller, 1993; Rauch et al., 2009). Therefore, EO is applied as a second-order construct in this study. A confirmatory factor analysis is performed to verify the measurement model's validity. Table 23 depicts the measurement items of the entrepreneurial orientation construct.

Innovation and Financial Performance

While some researchers have applied secondary data to assess performance, others have suggested to utilize surveys with self-reports for the measurement of organizational performance (Lonial & Carter, 2015; Wiklund et al., 2011; Wiklund & Shepherd, 2003). In prior research, it was determined that the correlations between EO and different performance measures were similar for both methods. Thus, both perceptual (subjective) performance measures from surveys and (objective) measures based on secondary or archival performance data lead to the same conclusions (Lonial & Carter, 2015; Rauch et al., 2009; Rosenbusch et al., 2013). Survey measures even allowed capturing a broader scope and multiple dimensions of performance compared to the use of archival data (Lonial & Carter, 2015).

Hence, the survey method appears appropriate to measure innovation and financial performance in this study. Chapter Two included already a detailed elaboration of innovation performance construct definitions and construct operationalization in the literature. The prior conceptual and hypotheses development section included an overview of financial performance definitions as well. Thus, Table 24 depicts the measurement items utilized for the performance constructs. For both performance outcome variables, established measurement scales were applied based on the literature.

Table 24
Measurement Items of Innovation and Financial Performance

Construct	Item Text
IP	Considering the most recent new product, service, or process development, please evaluate your organization's innovation success: My organization ... … Accelerated the commercialization pace of the new products or services by innovation … Made a considerable profit from its new products or services … Developed new technology to improve its operational processes … Purchased new equipment to enhance productivity
FP	Please rate the extent to which your organization has achieved the following product/service development objectives: … Total sales relative to stated objectives … Return on assets relative to stated objectives … Return on investment related to stated objectives … Profitability relative to stated objectives

Source: Adapted from Atuahene-Gima (1996); Wagner (2010); Chen & Huang (2009)

Control Variables

Several control variables were used to safeguard against potential influence on performance and thus to ensure generalizability of the findings (Wagner, 2010). Innovation and financial performance might be influenced by some demographic characteristics such as firm size because large organizations have easier access to essential resources and might have better opportunities to conduct supply chain resource orchestration with qualified, innovative suppliers. In the literature, firm size has been noted as an important predictor of innovation performance (Hurley & Hult, 1998). Another control variable, legal type (public, private), was applied to safeguard the generalizability of the findings. Possibly, privately held companies might have an advantage in forming SCRO relationships with key suppliers due to less stringent publication requirements

compared to publicly held companies. Moreover, privately held companies might have more leeway to act upon and implement innovative ideas, as a number of restrictions of publicly held companies do not exist. Cultural aspects such as the degree of formalization, power-sharing, tolerance for risk-taking, and nurturing a learning environments are all aspects that might all be affected by this attribute (Hurley & Hult, 1998). Hence, it was used as a second control variable. Finally, the selected innovation type was another control variable. The participants indicated whether internal development, buying, or joint development prevailed at the firm. Therefore, firm size (large, small), firm type (private, public), and innovation type (internal, buy, jointly) were used as control variables to verify potential influence on the findings.

Marker Variables

Finally, a non-correlating marker variable was used to determine potential common method bias impact (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003; Williams, Hartman, & Cavazotte, 2010).

Sampling / Data Collection

In this dissertation study, the unit of analysis is the organization (firm-level). To address the research questions, the preferred target respondents were business-to-business (B2B) managers and SCM professionals with a sufficient level of knowledge about new the product/service development activities in their organization.

To verify this requirement, the survey included screening questions. First, the participants' level of experience with innovation projects was used as a qualifying screening question at the beginning of the survey, and only participants with a good level (or higher) were

accepted for the subsequent survey. Second, all participants were required to answer a SCM topic question, and inacceptable answers led to the removal of the participant from the analysis. Therefore, based on use of screening questions, the respondents can be expected to have good knowledge about the new product/service development practices in their organization. Finally, the business-to-business (B2B) panel from Qualtrics was used with the limitation (quality check) that a maximum of 20% of the respondents might come from companies below 100 employees. In this way, it was ensured to have employees from a broad range of organizations ranging from below 100 people to large corporations with > 50,000 employees.

The survey questions focused on the participants' perceptions and assessment of their organization's supply chain orchestration practices and entrepreneurial orientation. Moreover, the participants were requested to evaluate the innovation and financial performance of their organization and answer questions to capture data for control variables.

For the data collection, a key informant approach was applied. Researchers have emphasized that single respondent are advantageous if they can provide specialized knowledge and insights about the desired phenomena (Kortmann, Gelhard, Zimmermann, & Piller, 2014; Kumar, Stern, & Anderson, 1993). In this case, the screening questions ensured that the participants were contributing a high level of experience with new product/service developments in their organization.

Common Method Bias

Common method bias (CMB) refers to a common bias in the dataset. An external influence (external to the measurement items) might bias the participants' responses (Lindell & Whitney, 2001). For example, utilizing the common method of an online survey instrument in this

dissertation research might have resulted in systematic response bias. As the research is based on a single key informant design, common method bias might have also influenced the findings (Guide & Ketokivi, 2015; Podsakoff et al., 2003). Researchers have noted that the existence of CMB might result in inflated observed correlations due to the cross-sectional research design with participants reporting their perceptions at the same time (in contrast to a longitudinal study) (Lindell & Whitney, 2001).

Hence, this research followed the guidance of other researchers to minimize the potential CMB impact (Kortmann et al., 2014). Several different proactive measures were taken in the survey design to avoid common method bias as much as feasible (Kortmann et al., 2014). First, the use of Qualtrics panel data ensured the anonymity of all participants to the principal investigator and thereby minimized the influence of social desirability bias (SDB) (Dillman, 2007). As SDB appears to correlate with CMB, reducing social desirability bias would likewise reduce CMB (Podsakoff et al., 2003).

Second, the independent and dependent variables were positioned in separate sections of the questionnaire to minimize the influence of potential common method bias (Podsakoff et al., 2003). Third, all hypotheses were specified in a positive direction (Swink & Song, 2007). As a quality check, it was ensured that the respondents confirmed a high level of relevant familiarity with new product and service development. Researchers have noted that such a procedure can help to mitigate single source bias (Mitchell, 1985).

Harmon's single factor test

Furthermore, following other researchers (Kortmann et al., 2014), the Harman's single factor test was conducted in SPSS to assess the potential influence of common method bias (CMB). In this

test, CMB is indicated when the majority of variance can be explained by a single factor. By examining the non-rotated solution for a single factor, it was assessed whether one factor accounted for the majority of the variance. If CMB were an issue, then such a single factor would have accounted for more than 50% of the explained variance in the model. The test was run twice. Initially, the test was performed for the original scale with all items. It was repeated at the end of the data analysis for the purified scale. In both instances, different extraction methods (maximum likelihood, principle axis factoring, and principle components) were used, and all results stayed noticeably below the threshold of 50%.

Moreover, the (unmeasured) common latent factor (CLF) technique was applied to assess the potential CMB concern (Riley, Klein, Miller, & Sridharan, 2016). In AMOS, a common latent factor (CLF) was added to the measurement model and connected to all observed items. All those paths from the CLF to the observed items were constrained as being equal. The result showed the common variance for the model. A chi-square difference test between an unconstrained model and a constrained model was performed. The absolute differences between the standardized regression weights of both models were less than .25 for all factors, which would suggest that CMB is not an issue.

Finally, a non-correlating marker variable question was included in the questionnaire to determine potential common method bias impact (Williams et al., 2010). This marker variable approach was suggested as a useful extension to existing CMB addressing research practices (Lindell & Whitney, 2001).

A theoretically unrelated construct was added to the model to refine the calculation of shared variance that can be attributed to CMB. Since the theoretical correlation to the other constructs is zero or close to zero, the common method error of the survey method can be

determined. Actually, the correlations to the marker variable were close to zero as expected, ranging from about -.06 to .07, which indicates that CMB was not an issue. Consequently, the results of the measures taken in survey design and the indications from the common latent factor, marker variable test, and the Harman's single factor tests would all suggest that the dataset in this research does not suffer from significant common method bias (Podsakoff et al., 2003; Schoenherr & Swink, 2012)

Pilot Test

Before roll-out of the main survey, a pilot survey with 25 participants (drawn from the Qualtrics B2B panel) was conducted. The intention was to verify whether the questions are understood and to identify any potential problems upfront. The data collected from the pilot was carefully scrutinized. All participants of the pilot passed the attention checks. There was no missing data. As a quality check, the author scrutinized the demographics data of the pilot sample, especially the experience of the participants, which was quite high. Overall, the participants showed sufficient length of employment and most had managerial responsibilities/roles. Straight-lining and other issues were investigated. The standard deviation for the IV and DV constructs was analyzed in Microsoft Excel. Several cases of answering pattern were recognized and flagged. Those cases were removed from the sample. Furthermore, the answering time was checked.

Screening of cases revealed no further anomalies (apart from the mentioned unengaged responses and the one speeder). No outliers were identified. The recorded time to answer all questions served as another indicator of quality. Speeders were removed from the sample. As the median response time was 655 seconds (10.9 minutes), the cut-off for speeding was set at 218 seconds (3.6 minutes), which is one standard deviation below the median duration.

Data Analysis Results (Main sample)

Data Screening

After the successful pilot test, the main sample was taken. Initially, the following data screening steps were taken with the collected data. The data was screened and assessed in terms of missing data, unengaged responses (e.g., straight lining issue), and correct answers to attention checks. First, all respondents recognized the three attention checks correctly which indicates that participants were generally engaged and attentive while answering the questions. Those three attention-check questions required selecting a different category each time. Second, there was no missing data as all mandatory questions were answered from the survey participants. A few questions were optional (e.g., job title) but more than 90% of the participants answered those optional questions as well. The responses were analyzed to identify potentially unengaged respondents. Speeders were excluded from the sample. As defined during the pilot test, one standard deviation below the median response (of 655 seconds) was used as a cut-off point (thus, speeder check at 218 seconds). One respondent took less than those 3.6 minutes and was removed.

Straight lining

The author reviewed the answers and particularly the standard deviation of all latent variables (excluding the control variables) to determine whether some respondents answered in a pattern. During the first round of data screening of the main sample, 14 respondents were identified with a straight lining pattern at least for SCRO and EO constructs. Thus, Qualtrics conducted an additional sampling, and 19 new cases were added while the poor-quality cases (including one speeder) were deleted).

Finally, after the additional, new cases were added, the response pattern for all dependent and independent variables was screened again by using Microsoft Excel. All participants now showed a nonzero standard deviation so that some deviation in their responses was noticeable. A visual check confirmed that participants did not show clear patterns when answering the latent variable questions. The potential for outliers existed only for control variables because for all other variables a (mostly 7-item) Likert-type scale was utilized. The screening of the controls did not reveal any outliers. As a result of the data screening, 247 complete, high-quality responses are available for the subsequent data analysis.

Demographics

The participants showed a relatively high level of responsibility in their respective organization. Apart from 11 % of owners (including partners), more than 70% held a managerial position. Specifically, nearly 40% of the participants noted titles such as CEO, COO, CFO, Director, (Senior) Vice President, or similar. Finally, 12.6% are employed in functional, non-managerial specialist roles and 4.9% did not disclose their job title (Table 25). The experience level (tenure) of the participants was relatively high as well. Nearly eighty percent of the participants noted five or more years of employment at their current organization. Specifically, about 37% of respondents have stayed at the organization for ten years or more, while less than 20% have stayed for less than five years. As such, the participants' extensive professional experience and managerial qualification should enable gaining a thorough perspective on the phenomenon of supply chain resource orchestration practices across a broad section of organizations (Table 25). The data revealed a good mix of companies in terms of size (Table 26) and industries (Table 27) as well as (primary) functional responsibilities (Table 28).

Table 25
Participant Experiences (Tenure) and Level of Responsibility

Number of Years Employed at Current Organization	Frequency	Percent	Cumulative Percent	Job Title / Responsibility	Frequency	Percent	Cumulative Percent
Less than 1 year	3	1.2	1.2	Manager, Supervisor, Head of a Function	79	32.0	32.0
1 - 4.9 years	46	18.6	19.8	Director, SVP, Vice President, Plant Mgr, General Mgr	58	23.5	55.5
5 - 9.9 years	106	42.9	62.8	CEO, COO, CFO	39	15.8	71.3
10 - 14.9 years	43	17.4	80.2	Specialist	31	12.6	83.8
15 - 19.9 years	19	7.7	87.9	Owner, (Managing) Partner	28	11.3	95.1
20 years or more	30	12.1	100.0	Undisclosed	12	4.9	100.0
Total	**247**	**100.0**		**Total**	**247**	**100.0**	

Table 26
Firm Demographics Data

Number of Employees	Frequency	Percent	Cumulative Percent	Estimated Annual Revenue (US$)	Frequency	Percent	Cumulative Percent
Less than 100	40	16.2	16.2	Less than $10 million	61	24.7	24.7
100 - 999	68	27.5	43.7	$10 million to $99 million	79	32.0	56.7
1,000 - 4,999	75	30.4	74.1	$100 million to $999 million	56	22.7	79.4
5,000 - 9,999	33	13.4	87.4	$1 billion to $9.9 billion	31	12.6	91.9
10,000 - 49,999	20	8.1	95.5	$10 billion to $49.9 billion	14	5.7	97.6
50,000 or more	11	4.5	100.0	$50 billion or more	6	2.4	100.0
Total	**247**	**100.0**		**Total**	**247**	**100.0**	

Table 27
Industry

Industry	Frequency	Percent	Cumulative Percent
Others (e.g., consulting, engineering, services)	62	25.1	25.1
Consumer products	48	19.4	44.5
Information technology, software	34	13.8	58.3
Industrial equipment, machinery, scientific tools	25	10.1	68.4
Banking, financial services, insurance	21	8.5	76.9
Chemicals, health care, pharma, biotech	15	6.1	83.0
Transportation equipment (e.g., automotive, aerospace)	15	6.1	89.1
Food and beverages, restaurants	12	4.9	93.9
Energy, utilities, oil & gas	7	2.8	96.8
Media, advertisement, communications	5	2.0	98.8
Electronics, electrical appliances	3	1.2	100.0
Total	**247**	**100.0**	

Table 28
Primary Functions of Participants

Primary Function	Frequency	Percent	Cumulative Percent
Marketing, Demand Mgt., Customer Service	58	23.5	23.5
Supply Chain Planning, Strategy, Sourcing/Procurement	57	23.1	46.6
Manufacturing / (Service) Operations	45	18.2	64.8
Supply Chain IT / Systems	42	17.0	81.8
Research & Development	23	9.3	91.1
Other	13	5.3	96.4
Logistics / Transportation	9	3.6	100.0
Total	**247**	**100.0**	

The functional supply chain expertise was distributed broadly, and the participants represented all important supply chain and related functions ranging from supply management/ procurement to manufacturing/ operations, research & development, information systems, logistics/ transportation, and marketing/ demand management (Table 28).

The Levene's Test of homogeneity of variances was conducted in SPSS to verify whether there are significant differences between the responses from large and small companies. The sample was split into two groups of either small (140 responses, revenue below $100 million) or large (107 responses, $100 million or more in annual revenues) and a means comparison test was conducted in SPSS. The ANOVA results suggest that there are no significant differences between both groups (t= 1.088, p= .280). The Levene's Test and an ANOVA were also conducted for public versus private companies and no differences were found as well (t= 1.860, p= .158). Finally, no significant differences existed between the groups of firms developing internally, developing with suppliers, and buying new innovative products from suppliers (t= 1.237, p= .516).

Invariance Tests

As prerequisite of the between-group mean comparisons, invariance tests (configural, metric, and scalar invariance) were conducted. Thereby, it was assessed whether the underlying measurement model is approximately the same for both groups (e.g., large and small firms) (Hair et al., 2010). With multi-group analysis in AMOS, the full scalar invariance was confirmed for the firm size and firm type groups. The unconstrained model for size was insignificant (p= .203). Thus, both groups (small and large firms) have a similar intercept (starting point) in the measurement model. Similar insignificant results for the unconstrained model were achieved for the groups of public and private firm. In conclusion, full measurement invariance was determined as the chi-square difference tests were nonsignificant.

Assessment of Normality

The standard normality checks were conducted (e.g., skewness and kurtosis checks). The dataset verification involved first an assessment of the descriptive statistics and second a visual check of the data plots (Vogt, Vogt, Elaine, Gardner, & Haeffele, 2014). Furthermore, conformance with the underlying statistical assumptions was verified in regards to normality, equal variance, or independence of sample (Hair et al., 2010). The absolute values of all measurement items were below the threshold values for skewness and kurtosis (Curran, West, & Finch, 1996; Dobrzykowski, McFadden, & Vonderembse, 2016; Yan & Dooley, 2014). Overall, the assessment did not reveal any significant issues with the fundamental assumptions. The following tables provide the descriptive statistics for SCRO (Table 29) and EO measurement items (Table 30) as well as the values for innovation and financial performance measures (Table 31).

Table 29
SCRO Descriptive Statistics

Scale Items	Mean	Std. Deviation	Skewness	Kurtosis	Standardized Loading	Apha if Item Deleted	Corrected Item-Total Correlation
SCRO - Structuring (Cronbach's Alpha = .904)							
Q4_2 - … obtains externally-available know how from the supply chain to complement...	5.58	1.233	-1.314	2.066	.782	.885	.743
Q4_3 - … invests in innovative technology developed by external companies from the...	5.72	1.309	-1.421	2.081	.771	.888	.730
Q4_4 - … renews its in-house process capabilities by adding expertise from supplie...	5.76	1.235	-1.367	2.531	.804	.882	.756
Q4_12 - … updates the in-house technology with supply chain input	5.62	1.313	-1.126	1.455	.863	.868	.820
Q4_5 - … captures knowledge from the supply chain	5.77	1.144	-1.361	3.038	.821	.885	.746
SCRO - Bundling (Cronbach's Alpha = .796)							
Q5_5 - … recombines external knowledge to create new organizational know how	5.70	1.015	-.768	1.456	.775	.702	.653
Q5_12 - … converts external knowledge into in-house capabilities	5.80	1.028	-1.171	2.526	.715	.720	.635
Q5_6 - … synchronizes internal with external innovation activities	5.62	1.162	-1.048	1.638	.761	.735	.625
SCRO - Leveraging (Cronbach's Alpha = .908)							
Q5_4 - … coordinates the product /service development activities with members of o...	5.81	1.137	-1.192	2.176	.791	.889	.765
Q5_2 - ... creates liaison position(s) that facilitate the information flow with o...	5.11	1.444	-.813	.359	.797	.891	.753
Q5_7 - … uses colocation between in-house experts and external development partner...	5.42	1.266	-.918	.889	.838	.886	.782
Q5_1 - ... emphasizes joint decision-making with key suppliers involved in new pro...	5.47	1.340	-.990	.650	.791	.892	.740
Q6_7 - … utilizes development capabilities to take advantage of market opportuniti...	5.95	.961	-.898	.915	.662	.905	.612
Q6_8 - … offers innovative solutions to customers based on joint development with...	5.71	1.201	-1.266	1.765	.724	.895	.707
Q6_9 - … deploys supply chain resources to create customer value in the marketplac...	5.76	1.188	-1.290	1.843	.756	.894	.720

Table 30
EO Descriptive Statistics

Scale Items	Mean	Std. Deviation	Skewness	Kurtosis	Standardized Loading	Apha if Item Deleted	Corrected Item-Total Correlation
EO - Proactive-Innovativeness (Cronbach's Alpha = .800)							
Q8_6 - Initiates actions which competitors then respond to	5.35	1.386	-1.012	.792	.806	.674	.681
Q8_13 - Is the first business to introduce new products/services, administrative te...	5.32	1.487	-.996	.447	.825	.632	.712
Q14_12 - Changes in product or service line have usually been quite dramatic	4.54	1.676	-.286	-.932	.610	.843	.529
EO - Risk-Taking (Cronbach's Alpha = .827)							
Q9_6 - A strong inclination for high risk projects (with chances of very high retu...	4.87	1.624	-.655	-.447	.824	NA	.705
Q10_9 - Bold wide-ranging acts are necessary to achieve the firm's objectives	5.29	1.419	-.889	.345	.853	NA	.705
EO - Autonomy (Cronbach's Alpha = .700)							
Q10_10 - The best results occur when individuals and/or teams decide for themselves...	5.25	1.403	-.866	.499	.609	.647	.486
Q11_9 - Supports the efforts of individuals and/or teams that work autonomously	5.84	1.160	-1.391	2.658	.672	.652	.473
Q13_11 - Employee initiatives play a major role in selecting the innovation opportu...	5.39	1.251	-1.197	1.943	.712	.505	.589
EO - Competitive Aggressiveness (Cronbach's Alpha = .788)							
Q8_14 - Adopts a very competitive "undo-the-competitors" posture	5.09	1.526	-.815	.138	.822	NA	.650
Q8_12 - Acts very aggressive and intensely competitive	4.88	1.575	-.691	-.228	.784	NA	.650

Table 31
Innovation and Financial Performance Descriptive Statistics

Scale Items	Mean	SD	Skewness	Kurtosis	Standardized Loading	Apha if Item Deleted	Corrected Item-Total Correlation
Innovation Performance (Cronbach's Alpha = .863)							
Q17_2 - Accelerated the commercialization pace of the new products or services by i...	5.52	1.271	-.938	.943	.807	.819	.726
Q17_3 - Made a considerable profit from its new products or services	5.53	1.232	-1.073	1.308	.770	.841	.671
Q17_4 - Developed new technology to improve its operational processes	5.56	1.384	-1.093	.915	.784	.802	.766
Q17_5 - Purchased new equipments to enhance productivity	5.66	1.404	-1.365	1.626	.712	.836	.687
Financial Performance (Cronbach's Alpha = .868)							
Q18_2 - Total sales relative to stated objectives	5.43	1.177	-.780	.810	.762	.846	.682
Q18_3 - Return on assets relative to stated objectives	5.32	1.222	-.705	.755	.790	.826	.732
Q18_4 - Return on investment related to stated objectives	5.40	1.188	-.700	.978	.774	.838	.704
Q18_5 - Profitability relative to stated objectives	5.49	1.189	-.832	1.058	.819	.815	.760

Scale Purification (CFA)

Confirmatory factor analysis (CFA) was performed in AMOS Version 24 to achieve scale purification. The CFA was using the maximum likelihood estimation (MLE) method to iteratively enhance the parameter estimations and goodness-of-fit between the specified measurement model and the sample data (Byrne, 2010). Primarily the modification indices and factor coefficients were considered during those iterative purification steps.

Following the other researchers, only one item was changed at a time (Li et al., 2005). Theoretical justification was determined before any measurement item was altered. The focus was to minimize the discrepancy between the sample covariance matrix and the covariance matrix implied by the hypothesized model (Byrne, 2010). The CFA was conducted to assess SCRO, EO, IP, and FP individually first and subsequently to assess the entire measurement model.

The AMOS software package was used to assess the measurement model. The most commonly applied fit indexes were calculated to evaluate the fit between theorized model and actual data. For example, the chi- square statistic (χ^2) measures the difference between the sample covariance and the fitted covariance. However, the "chi-square index is sensitive to sample size and departures from multivariate normality." (Li et al., 2005, p. 627). Hence, in this study, multiple fit criteria are evaluated and reported to minimize the potential impact of measuring biases (Byrne, 2010; Hair et al., 2010).

Assessment of Construct Validity

To assess construct validity of the measurement items, four different aspects of validity and reliability were considered (Bagozzi, Yi, & Phillips, 1991):

(1) Content validity

(2) Internal consistency of operationalization (unidimensionality and reliability)

(3) Convergent validity

(4) Discriminant validity

Content Validity

Content validity reflects whether the measurement items are fully covering the variable domain and thereby all the essential aspects of the latent variable being measured (Hair et al., 2010). For example, researchers have ensured content validity of a survey instrument by conducting thorough literature reviews and by requesting a complementary review of the items from knowledgeable scholars and practitioners (Li et al., 2005). The determination of content validity is non-numerical and based on a "rational judgmental process not open to numerical evaluation" (Li et al., 2005, p. 627). Researchers have highlighted that the wording of survey questions is highly critical to avoid any ambiguity (Schwarz, 1999).

Hence, in several steps, practitioners and scholars were asked to review the survey items and to verify whether the items truly reflect the variables. The reviewers assessed the survey in terms of measurement item clarity, the appropriateness of questions, survey completeness, for example. Eventually, a final agreement was found. Based on the extensive literature review (including Chapter Three), the pilot testing, and the key contributions from scholars as well as practitioners, content validity of the measurement items is assumed as sufficient.

Construct validity indicates whether different traits (behaviors) actually are relating to the same constructs (convergent validity) and whether theoretically distinct constructs are actually related or not (discriminant validity) (Peter, 1981). Furthermore, it reflects whether a

nomological network is established due to interrelated laws supporting a construct and due to the identification and assessment of traits related to each additional construct

Reliability

Typically, the Cronbach α coefficient has been used to evaluate reliability (Cronbach, 1951; Nunnally, 1978). Researchers consider a measurement scale to be reliable and consistent if the alpha coefficient is .70 or higher even though emerging criticism about a rigid, uncontextualized use is acknowledged (Guide & Ketokivi, 2015; Sijtsma, 2009). In this study, the Cronbach's α was calculated for each measurement item, and all coefficients passed the .70 threshold, suggesting acceptable construct reliability (descriptive statistics Table 29 to Table 31). Furthermore, the composite reliability (CR) was calculated, and the scale items were all greater than .70 suggesting good internal consistency (Wagner, Grosse-Ruyken, & Erhun, 2012).

Convergent Validity

The measurement items are considered as reflective of their latent construct (Diamantopoulos & Winklhofer, 2001). Therefore, each individual item in the scale is reflecting the underlying latent construct, and serves as a different approach to measuring it. Convergent validity assesses the extent to which one measurement item is similar to (converges on) another measurement item to which it theoretically should be similar (Hair et al., 2010). "Two or more measures of the same thing should covary highly" as valid measures of the same concept (Bagozzi et al., 1991, p. 425).

To assess convergent validity, it is determined if all items are convergent on their respective latent construct, meaning the items share a high proportion of variance in common. An item loading of above .70 has been used as an indication of sufficient convergent validity

because the factor is explaining more than half of the variation in the item (Hair et al., 2010), and the individual item loadings meet this threshold (Table 29 through Table 31).

The average variance extracted (AVE) is calculated for each construct to estimate the level of true variance captured by each latent construct (Riley et al., 2016). An AVE of greater .50 is considered as indicative of sufficient convergent validity because the majority of variance is related to its construct (Fornell & Larcker, 1981). Finally, the good overall model fit of the measurement model indicates convergent validity as well. Table 32 summarizes the AVE values for all four latent constructs. The values in Table 32 indicate that all AVE values are above .50 suggesting sufficient convergent validity (Fornell & Larcker, 1981).

Discriminant Validity

Discriminant validity reflects the independence of the measures from each other (Li et al., 2005). It is an assessment of the extent to which one measurement item is dissimilar to or diverges from another measurement item to which it theoretically should be distinct (Peter, 1981). Thereby, discriminant validity is concerned with the uniqueness of the measures in comparison to the other measurement items (Bagozzi et al., 1991) and assesses the extent to which the measures for different latent constructs are distinctly different from each other.

Discriminant validity was first assessed using the average variance extracted method (Fornell & Larcker, 1981). It was determined whether the average variance extracted for each pair of constructs was greater than their squared correlation. It was also examined whether any single item loaded more highly on another construct than on the one it was intended to measure. The analysis indicated discriminant validity of SCRO because the composite reliability (CR) was greater than the AVE and the maximum shared variance (MSV) was less than the AVE.

Table 32
CFA (Convergent and Discriminant Validity Results)

	CR	AVE	IP	SCRO	EO	FP
IP	.856	.602	**.776**			
SCRO	.943	.848	.852	**.921**		
EO	.919	.741	.894	.832	**.861**	
FP	.869	.624	.864	.778	.814	**.790**

Standardized correlations in lower bottom triangle; diagonal: square root of AVE

Furthermore, the square root of the AVE was greater than the correlation to the other constructs. Hence, discriminant validity was concluded for SCRO.

However, the indications for EO and the performance constructs was mixed. The CR value was greater than the AVE for all three constructs, but the MSV was not less than the AVE. For EO, the correlation to FP and SCRO was less than the square root of the AVE, as required. However, this was not true for the correlation between EO and IP. A theoretical consideration might explain this result. There is a high correlation between EO and both performance constructs, as it would be conceptually expected. Theoretically, this can be comprehended as innovativeness or proactiveness are dimensions of EO, which are expected to correlate highly with organizational performance. Therefore, the traditional AVE comparison test might not be applicable in this case so that additional discriminant validity tests are performed.

Following Hair et al. (2010), the discriminant validity of entrepreneurial orientation was assessed by comparing model fit of two alternatives. First, a new model is constructed with all measurement items assigned to only one new combined construct (EO and IP, then EO and FP).

Second, the model fit was compared to a 2-construct model. In both model comparisons (IP and FP), the model fit deteriorated for the combined model so that the baseline model with distinct constructs of EO, IP, and FP showed superior model fit. The model fit was significantly different ($p < .0001$).

An additional test of discriminant validity was conducted. Innovation and Financial Performance were modeled as first-order constructs of organizational performance. The criteria for discriminant validity were met for the second-order performance construct, with the composite reliability score substantially greater .70 threshold, CR greater than AVE, and the maximum shared variance less than the AVE (Table 33).

For Perform (second-order construct of first-order IP and FP constructs), the composite reliability (CR) value is greater .70, the CR value is greater than the AVE, and the MSV is less than the AVE. Furthermore the square root of the AVE equals .932, which is greater than the standardized factor correlations with SCRO (.875) and EO (.917). In conclusion, the test of discriminant validity appears to indicate that EO is a unique construct and captures traits that are distinct from the innovation performance and financial performance constructs, so that discriminant validity is suggested for this measurement model.

As a final step of the CFA, the model fit of the entire measurement model was calculated, which showed excellent model fit ($\chi^2 = 724.321$, $df = 477$, $p < .0001$; CFI = .954). It can be concluded that the CFA results show excellent fit between the measurement model and the sample data. Hence, the overall model fit indicates good construct validity as well. Table 34 summarizes the model fit assessment results.

Table 33
Discriminant Validity for Second-order Factor of Performance

Construct	CR	AVE	MSV	EO	SCRO	PERFORM
EO	.919	.741	.841	**.861**		
SCRO	.943	.848	.766	.832	**.921**	
PERFORM	.930	.869	.841	.917	.875	**.932**

Standardized correlations in lower bottom triangle; diagonal: square root of AVE

Table 34
Measurement Model Results (CFA)

Parameter	Result	Threshold	Conclusion
χ^2/df	1.518	< 3	Valid model
CFI	.954	> .90/.95	Valid model
RMSEA 90% Confidence interval:	.046 Low90 = .039 High90 = .053	< .06	Valid model
PCLOSE	.841	> .05	Valid model

Cook's Distance

Finally, a test of cook's distance was performed to determine the existence of any extreme cases, which significantly influence the model's findings. Any cases with a distance above d= 1.0 would be considered as influential outliers. The test was conducted for SCRO and EO. However, no anomaly was found in the dataset. The maximum distance was around d= .35 for SCRO and below d= .12 for EO so that all cases were kept in the sample. The multivariate normality was verified with the final measurement model. To conclude: In no cases did a respondent exhibit a high influence on the analysis results (no respondent was an influential outlier) because Cook's Distance values were substantially below the d= .50 threshold (Liu, 2015) as displayed in the Cook's Distance calculations for EO (Figure 9).

Structural Model Analysis and Hypotheses Testing

Multi-Collinearity Analysis

Initially, a multi-collinearity analysis was performed involving only the second-order predictors (SCRO, EO) and the dependent variables Innovation Performance (IP) and Financial Performance (FP). The multi-collinearity test was run in SPSS with entrepreneurial orientation and supply chain resource orchestration (second-order constructs) and with three control variables for both innovation performance and financial performance. The imputed factor scores (derived through the AMOS program) were used (weighted average of all cases for each latent variable). Conclusion: All variance inflation factors (VIF) were below the VIF= 5 threshold (Cheng, Cantor, Grimm, & Dresner, 2014; Jacobs, Swink, & Linderman, 2015; Mackelprang & Malhotra, 2015). The VIF values were identical for IP and FP (Table 35).

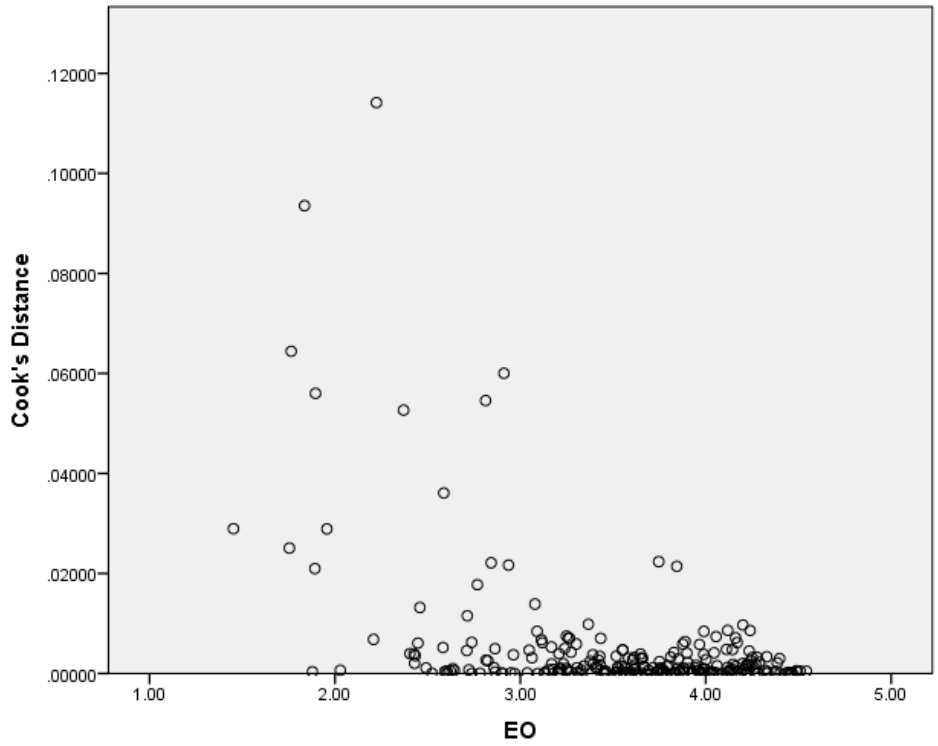

Figure 9 - Cook's Distance Calculation for EO

Table 35
Multi-Collinearity Verification

	Collinearity Statistics for IP and FP	
	Tolerance	**VIF**
Control (Innovation Type)	.988	1.012
Control (Firm Size)	.974	1.027
Control (Firm Type)	.969	1.032
EO	.208	4.797
SCRO	.211	4.742

Structural Path Model and Direct Effects

In AMOS 24, a structural (path) model was created with EO and SCRO as exogenous variables, IP and FP as endogenous variables, and three exogenous control variables (firm size, firm type, innovation type). The structural model showed excellent model fit to the dataset in the test. (χ^2= 836.925, df=568, p< .0001, χ^2/df = 1.473, CFI = .950, RMSEA = .044 (RMSEA 90% confidence interval: Low90 = .037, High90 = .050), PCLOSE = .948).

The coefficients for the direct paths between SCRO/EO and the performance constructs were all significant at either the p= .10 or p= .01 level. Hypotheses $H_{1A/B}$ between SCRO and IP/FP were confirmed, with both paths found significant (IP: β = .294, p= .002; FP: β = .232, p= .029) at the p= .05 level.

Hypotheses $H_{2A/B}$ between EO and IP/FP were confirmed, with both paths found significant (IP: β = .665, p< .001; FP: β = .661, p< .001) at the p= .01 level. Thereby, Hypotheses $H_{1A/B}$ and $H_{2A/B}$ were confirmed. In this baseline path model, the endogenous variables IP (r^2 =.874) and FP (r^2 = .741) explained a high portion of the variance. Finally, bootstrapping with 2000 iterations was performed to test the robustness of the model. The excellent model fit was confirmed (Table 36).

Moderation / Interaction Effects

The interaction between SCRO and EO was tested in a structural model involving three control variables (firm size, firm type, innovation type). The model showed excellent fit (χ^2= 891.914, df=598, p< .0001, χ^2/df = 1.491, CFI = .946, RMSEA = .045 (RMSEA 90% confidence interval: Low90 = .038, High90 = .051), PCLOSE = .926).

Table 36
Structural Path Model Results

Parameter	Result	Threshold	Conclusion
χ^2/df	1.473	<3	Valid model
CFI	.950	> .90/.95	Valid model
RMSEA 90% Confidence interval:	.044 Low90 = .037 High90 = .050	< .06	Valid model
PCLOSE	.948	> .05	Valid model

In this model, the endogenous variables IP (r^2 =.888) and FP (r^2 = .768) explained a high portion of the variance. The interaction effect on FP was significant (t= .172, p= .002) at the p= .01 level, confirming Hypothesis H_{3A}. As displayed in Figure 10, **entrepreneurial orientation strengthens the positive relationship between supply chain resource orchestration and financial performance** as the regression shows a higher level (higher y-intercept) and slope for high EO levels than for low EO levels. However, for innovation performance, the interaction effect was not significant (t= .028, p= .562) so that Hypothesis H_{3B} was not confirmed.

Structural Model (with Moderation Effects)

The structural model showed excellent model fit indicating that the empirical data fits very well to the structural model (Table 37). Finally, the results of the hypotheses testing are summarized in the concluding Table 38.

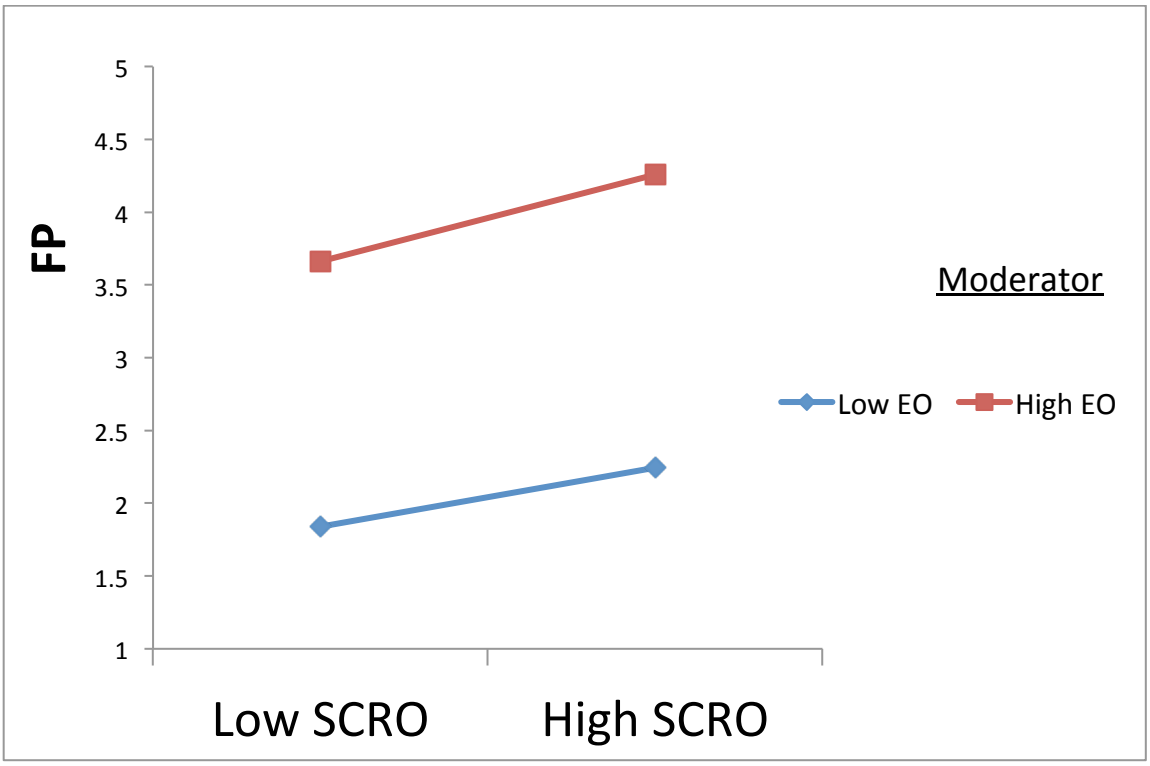

Figure 10 - Interaction Effect on Financial Performance

Table 37
Structural Model Fit Comparison

Model	χ^2	**Prob.**	**Df**	χ^2/df	**CFI**	**RMSEA (90% confidence interval)**	**PCLOSE**
Baseline Full Path Model 90% Confidence interval:	836.925	< .0001	568	1.473	.950	.044 Low90 = .037 High90 = .050	.948
Moderation (Full Model) 90% Confidence interval:	891.914	< .0001	598	1.491	.946	.045 Low90 = .038 High90 = .051	.926

Table 38
Summary of Hypotheses Testing

Hypothesis	Parameter Estimate	Probability	Conclusion
H_{1A} H_{1B}	.294* .232*	P = .002 P = .029	Confirmed Confirmed
H_{2A} H_{2B}	.665*** .661***	P < .001 P < .001	Confirmed Confirmed
H_{3A} H_{3B}	.028 .172**	P = .562 P = .002	Not confirmed Confirmed

Standardized parameter estimates; * p< .05; ** p< .01; *** p< .001

Discussion and Contribution

Theoretical Contribution

This research attempts to achieve several theoretical contributions. First, the existing supply chain management literature stream is extended by empirically testing a conceptual model of SCRO. The positive effect of SCRO on both innovation and financial performance was confirmed. Furthermore, it was demonstrated that entrepreneurial orientation strengthens the positive relationship between SCRO and financial performance.

Second, the SCM perspective of open innovation is extended by highlighting the important role of managerial orchestration practices within the open innovation framework. This research demonstrated the positive contribution of effective resource orchestration practices on organizational performance. The study illustrated how fruitful the innovation research domain can benefit from operational, micro-level supply chain research. Supply chain resource

management appears to develop an emerging body of knowledge to which this study intended to contribute. Thereby, the call for more research on the supply side within the open innovation approach was also addressed with this study by confirming the critical performance impact of supply chain resource orchestration.

Third, this research study will help to better understand the attitudinal impact (of proactive innovativeness, risk-taking, autonomy, and competitive aggressiveness) on the SCRO-performance relationship. Interestingly, the scale purification resulted in combining innovativeness and proactivity for this dataset. Hence, this research provides a new perspective to the ongoing debate about the best operationalization of entrepreneurial orientation.

Furthermore, the confirmation of the SCRO framework contributes to the resource orchestration theory stream. It is a further step in providing empirical validation to that emerging theory. The SCRO operationalization can serve as a foundation for future studies. For example, the leveraging construct appears to relate not only to the relationship with customers but more broadly to other supply chain constituents as well. Based on the current literature, this was a rather surprising finding and might indicate a future research opportunity.

Another contribution relates to the combination of supply management and entrepreneurship literature streams to address a phenomenon at the intersection of both fields. The research findings bridge both fields and might help to overcome the current separation. Finally, the relatively fragmented literature stream on open innovation from a supply chain management's perspective is synthesized and guidance for further research is provided. A new cumulative body of knowledge, drawing from both SCM and innovation literature streams, appears to be emerging. This study was intended to provide new insights as a first step in the direction of cross-disciplinary knowledge building.

Managerial Implications

As managerial implication, the study will enhance awareness of the critical performance consequences of supply chain resource orchestration. To enhance innovation and financial performance, managers need to attend to a good balance of the three sub-processes of structuring, bundling, and leveraging. Furthermore, this research has demonstrated the moderating effect of entrepreneurial orientation.

This will draw the practitioners' attention towards the firm-level attitudinal factors impacting organizational performance. Cultural aspects matter and can even strengthen the performance consequences of solid, effective managerial practices in terms of supply chain resource management.

Additionally, managers will better understand the opportunity for the supply chain management function to enhance its strategic role within the organization. The objective is to develop effective resource acquisition, identification, integration, and re-configuration as well as exploitation practices in the organization. Supply chain managers could thereby play a major role in establishing new, competitive SCRO capabilities that are highly difficult to imitate. This should create a competitive advantage in the marketplace. Meanwhile, managers have become aware of complementary cultural factors and could assess the current fit and potential opportunities for improvement within their organization in this regard.

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CHAPTER FIVE – CONCLUSION

Conclusion

This concluding chapter offers a brief summary and integration of the findings from the three dissertation research studies, addresses theoretical and practical implications, outlines research limitations, and provides suggestions and direction for future research. The purpose of this research was to examine how supply chain management practices can enhance innovation and financial performance of the organization. Based on existing literature and resource management theory, a conceptual model of supply chain resource orchestration was developed. The new SCRO framework was empirically tested and the positive effects of SCRO on organizational performance were confirmed. Furthermore, the important interplay between SCRO and organizational culture was conceptually developed and subsequently quantified.

Theoretical Contribution

This research makes several significant contributions to the body of knowledge at the intersection between supply chain management and innovation management. Thereby, a new integrative theoretical perspective is developed, bridging supply chain, innovation, marketing, and strategic management literature streams. By responding to calls for more research, this dissertation is contributing to the aspects of resource management practices, resource management theoretical domain, theory elaboration methodology, and cultural performance implications.

Even though buyer-supplier relationships and supplier involvement in innovation have been studied for decades, research is lacking in terms of concrete managerial *practices* about the orchestration of key supply chain resources to support innovation activities. Thereby, the

research findings will assist in gaining a deeper understanding of the performance effects of supply chain resource orchestration. The dissertation provides new insights into the implications of organizational culture, especially innovation culture, on managerial practices in general, and supply chain resource management in particular.

This research contributes with the development and empirically validation of the SCRO framework and the quantification of the performance consequences of SCRO practices. Researchers have called for more research concerning the operational, micro-level practices of resource management, particularly involving resources outside of the company's boundaries (Crook and Esper, 2014). In this regard, both the case study and the survey research provide a new perspective and illustrate concrete SCRO practices along with their performance implications. This research might create the foundation to better understand the practices of how external resources are successfully orchestrated, including the important aspects of resource integration and exploitation.

Another major theoretical contribution relates to the extension of resource management theory. The domain of the current resource orchestration theory is broadened to encompass supply chain resource orchestration as an additional phenomenon. In the context of innovation, particularly concerning collaborative new product and service development, this research has described SCRO practices and confirmed its performance implications, which enhances both depth and breadth of the resource orchestration theory. Thereby, a new direction for future research endeavors in resource management is indicated. Based on the employment of theory elaboration, case study, and survey methodologies, the newly developed and tested SCRO framework has enriched and contextualized the extant resource management theory.

A related methodological contribution might lie in applying the theory elaboration approach (Ketokivi and Choi, 2014), which has not received a lot of attention in the supply chain management literature yet. Overall, the research is based on complementary research methodologies, which help to offset weaknesses of each individual method (McGrath, 1981).

Moreover, the findings illustrate the complex relationship between SCRO practices and organizational culture. The research has demonstrated the critical consequences particularly of innovation culture on the effectiveness of SCRO practices. Without a fit of culture, SCRO practices remain less effective. Managing supply chain resources necessitates a matching cultural environment. In particular, the case study findings contribute by enabling to gain a deeper understanding of the opinions, activities, and processes that occur at the interplay between SCRO practices and organizational culture.

Implications for Practice

The findings of this dissertation research might have several implications for supply chain, innovation, and marketing managers. Possibly most significantly, this research suggests that supply chain management practices can have a positive direct effect on innovation and financial performance. The study results have demonstrated that well-balanced efforts in structuring, bundling, and leveraging can enhance organizational performance. Furthermore, establishing an innovation-supporting culture within the organization can strengthen the financial performance benefits of SCRO practices even further. It appears critical for manager to comprehend the SCRO framework and its consequences when taking decision about the acquisition and integration of supply chain resources. Specifically for the purchasing function, this research

might indicate the importance of effective resource integration and leveraging because the resource acquisition sub-process is insufficient by itself. Hence, purchasing managers might be well advised in striving for better cross-functional integration in addition to enhanced inter-organizational integration with key suppliers in order to drive innovation in their company.

The case studies as well as the subsequent survey research have both indicated the critical aspect of leveraging resources. While theory has suggested to synchronize structuring, bundling, and leveraging practices, the case companies appear to put less emphasis on leveraging and commercialization activities. Managers might benefit from reflecting upon or reconsidering their companies' leveraging processes to avoid a detrimental imbalance among SCRO practices. Not surprisingly, the two case companies that were ahead in terms of leveraging practices showed also the far better financial returns. Thus, this research might assist managers in this regard as the performance implications have been illustrated. Another interesting finding of the case study relates to an apparent neglect of resource divesture activities. For purchasing managers, an emphasis on acquisition might appear plausible. Nonetheless, this research might initiate better portfolio management in organizations and assist practice with how to better structure a portfolio of supply chain resources, which includes the necessary divesture of resources as well.

Another practical implication concerns organizational culture, and a quote from the case interviews provide an interesting insight. Since innovation is becoming increasingly complex and requires more attentiveness to cultural issues, a supply chain manager from a global logistics equipment industry distinctly noted:

> "The first thing is the culture of our company. Engineering allowing our supplier to own it, have the responsibility, that is the key thing, is to let go of that" (Thomas, Senior Supply Manager)

By understanding the implications of innovation culture and its interplay with SCRO, managers might more effectively assess and balance the trade-offs of their strategic innovation-related supply chain decisions. These insights could help managers make better strategic and operational decisions, driving innovation performance and thereby enhancing the competitive position of their organization. Overall, this research might assist organizations in reducing the failure rates of innovation while supporting management in strengthening the competitive situation of their company.

Limitations

A theoretical model emerged from the systematic literature review and was refined through a constant comparison technique, alternating between literature (theory elaboration) and practitioners' interviews, to develop the new SCRO framework. This conceptualization of supply chain resource orchestration was then tested with a survey instrument, with structural equation modeling used for the data analysis. Thereby, limitations remain and are discussed in this section.

By focusing solely on the resource inflow from collaborative suppliers but not customers or competitors, the boundary conditions of this research are limited to the upstream supply chain. Future research might expand the application of SCRO from the supply network to other external constituents. Participant of the case study came from the high technology industry environments, limiting the generalizability. Follow-up interviews with participants from a different environment such as small and midsize firms or from another cultural background could complement interesting new insights.

The survey is based on the B2B panel data from Qualtrics. Scholars have commented on limitations in regards to the use of panel data for survey research (Schoenherr, Ellram, & Tate, 2015). This concern is related to the actual population characteristics, survey administration, response rate measurement, or data quality, for example. Different sources of bias need to be acknowledged. The motivation to get paid might result in a sampling bias. Non-response bias is difficult or impossible to assess because the total number of successful solicitations remains unknown. How many people have actually received the invitation and purposefully decided not to respond versus how many mails were lost in a spam filter, for example? Even though qualifying questions and attention checks were applied, a risk of misrepresentation might remain. Plausibility checks were made, but the participants remained anonymous to the principal investigator. Therefore, future replication could address those limitations and verify the robustness of the findings.

The questionnaire was based on existing and adapted scales (e.g., entrepreneurial orientation) but little prior measurement instruments were applicable to operationalize SCRO. Future research could refine the scale development of the SCRO instrument. Other limitations are the result of the research design. The performance measurement was based on individuals' perceptions concerning innovation and financial performance. Even though it is a very common approach, this assessment remains inherently subjective. Furthermore, the survey was based on a single respondent. Hence, future research might utilize secondary data and possibly multiple respondents. The theoretically expected time lag between innovation and financial effects could be addressed with archival data as well.

Future Research Opportunities

This dissertation research represents only an initial step in the development and refinement of the SCRO framework, and not all critical aspects are fully addressed yet, so that fruitful research opportunities remain. Further research is required to expand the SCRO framework and to define its boundary conditions. After the basic conceptual model was quantitatively and qualitatively confirmed with a case study and a survey methodology, subsequent research should continue with additional empirical validation of the SCRO framework. As the importance of the open innovation paradigm continues to grow due to the strategic necessity of innovation, further research on the managerial practices along with cultural implications appears warranted. For example, the SCRO framework could be tested in different settings to verify its robustness in varying environments. Longitudinal research could strengthen the conceptual understanding by investigating how the SCRO relationships hold over time.

The literature review has identified a lack of coherence in the body of knowledge concerning supply chain resource orchestration and innovation. The two streams appear to be divided. The issue of fragmented knowledge can be overcome by focused scholarly efforts to close the identified research gaps and to integrate and draw from both respective literature streams. The proposed research agenda of Chapter Two can provide a starting point in this regard. Future research could focus on several important issues on the strategic as well as operational level of SCRO. As the SCRO framework is emphasizing more the micro level of operational practices, further research could address the strategic implications for the organization. One research opportunity relates to the strategic role of SCM in driving innovation. While engineering and marketing appear to be established functional "players," the interviews with practitioners have revealed noticeable differences in terms of level of innovation-related

contribution and responsibility for the SCM discipline. Future research might explore the strategic implications for supply chain management.

Finally, future research might bridge the SCRO phenomenon with the literature stream of absorptive capacity. Possibly, SCRO might be understood as a further dimension of the latter construct. Thereby, SCRO might be complementary to the current focus on engineering and R&D-related competences and capabilities. The engineering-SCM relationship could become the subject of future research, especially in the context of new product/service development activities.

References Chapter Five

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VITA

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