Contributions to Management Science

Stephanie Hintze

Value Chain Marketing

A Marketing Strategy to Overcome Immediate Customer Innovation Resistance

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Stephanie Hintze
Hamburg
Germany

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Foreword

Suppliers of raw materials, parts, and components often face a dilemmatic situation: While severe competition pushes them towards innovation they often have to realize severe barriers to the implementation of their new products. One challenge arises from the fact that purchasing decisions of the immediate customer are often influenced by multiple entities in the value chain, for instance, by engineering consultants or manufacturers of complementary products. This requires the suppliers to target their marketing activities to multiple parties. Another challenge is that the value associated with a new supply may hardly be evident for the immediate customer and becomes more relevant when the raw products get closer to their end applications.

Material suppliers facing this situation may engage in broader marketing activities by not exclusively focusing on the immediate customers. Value Chain Marketing basically consists in addressing the downstream customers and all other entities influencing the purchasing decisions in order to get innovations pulled through the value chain. The present research work investigates Value Chain Marketing and focuses on the relationship between the supplier, his immediate customers, and the downstream customers. This research is conducted in the chemical industry. The suppliers investigated here are specialty chemical companies selling coating and sealing additives to customers that process these additives into intermediate products (e.g. paint and varnish, textile fibers, sealing material, and packaging material). The downstream customers are either OEMs (e.g. automotive manufacturers, shipyards) or brand owners in the FMCG sector.

Relying on this empirical setting, Stephanie Hintze aims at answering three key research questions:

(1) Which factors impact the applicability and success odds of Value Chain Marketing?
    In a pilot study, Stephanie Hintze analyzes suppliers' innovation marketing activities for different application fields of coating and sealing materials. By

this cross-sectional analysis, she is able to identify those contextual factors which make Value Chain Marketing more promising.

(2) Which are viable approaches and activities in Value Chain Marketing?
For the investigation of this question, Stephanie Hintze conducts a thorough multi-case study based on interviews involving representatives of suppliers, immediate customers, and downstream customers. She is able to develop propositions regarding the success odds of different Value Chain Marketing activities.

(3) What are the key success factors for Value Chain Marketing?
The results of the two qualitative studies culminate in a third study by providing the input of an agent-based simulation drawn upon the SKIN model (Simulating Knowledge Dynamics in Innovation Networks). The simulation results allow deriving clear recommendations for doing successful Value Chain Marketing under different conditions.

This research work shows very distinct results which have been achieved by the intelligent use of sophisticated research methods. In particular, the combination of empirical work with an agent-based simulation represents an original and fruitful approach which has hardly been used in innovation and marketing research so far. This work is therefore innovative and contributes significantly to the state-of-the-art knowledge on innovation marketing in complex value chains. As the results will help suppliers of parts and raw materials to increase the success of their marketing activities, the present work also has a clear practical relevance. It shows promising ways to a successful market implementation of supplier innovations. To sum up, Stephanie Hintze has delivered a work containing all ingredients of a formidable and relevant research.

Hamburg, Germany Christian Lüthje

Preface

This book is based on my dissertation which I have conducted at the Institute of Innovation Marketing at Hamburg University of Technology (TUHH) from 2009 to 2013. It focuses on Value Chain Marketing (VCM), representing a promising marketing strategy to overcome immediate customers' innovation resistance. Suppliers enlarge their target group beyond their immediate customers and address their downstream customers as well by pursuing VCM. In three subsequent studies, I explore the relevance of VCM in real-world examples and deeply analyze the VCM process. I identify the critical factors for supplier's marketing success and compare the performance of VCM trials. The results of my dissertation contribute to the planning and management of suppliers' marketing projects. Suppliers can use the VCM model as a tool to support their strategic decision on how to implement their innovation best.

The successful completion of my dissertation has been made possible thanks to the support of my supervisors, colleagues, friends, and family.

First, I want to thank Prof. Dr. Christian Lüthje for being my doctoral advisor and supervisor. His openness to new methodological approaches and his visionary thinking provided a unique environment to spark creativity. I benefited from the inspiring discussions, teaching opportunities, and the chances to transfer my knowledge into academic conferences and workshops.

I also thank my doctoral co-advisor, Prof. Dr. Petra Ahrweiler from the EA European Academy GmbH and JGU Mainz, for her generous support during the dissertation process. The many discussions with her and her enthusiasm to simulate the VCM phenomenon by using an agent-based approach have been a great motivation for me.

I am also grateful for the support of my colleagues, some of who have become true friends to me. We had lots of engaging and thoughtful discussions on academia and private matters. I would like to particularly thank Mareike for rigorous academic debates and exchanges as well as for activities beyond academia. My appreciation also goes to Iris who started my interest in agent-based modeling and simulation. I owe further thanks to my students who have supported me, the interview partners whom I talked to, and the firms that took part in my case study.

Finally, I thank my friends for the critical debates, reviewing the manuscript, and especially for being there. Without them it would not have been possible to complete this research project. My greatest thanks go to my family for their love and support during all stages of my life.

Hamburg, Germany Stephanie Hintze

List of Abbreviations

Content-Specific Abbreviations

ABM	Agent-based modeling
ABS	Agent-based simulation
ANOVA	Analysis of variance
B2B	Business-to-business
B2C	Business-to-consumer
BU	Business unit
c-VCM	Cooperative VCM
DIY	Do it yourself
DMF	Dimethyl formamide
DOE	Design of experiment
ECS	European Coating Show
EU	European Union
FDI	Functionality-driven innovation
FSA	Food Safety Authority
HC	Hydrocarbons
IMO	International Maritime Organization
LISP	List processing language
nc-VCM	Noncooperative VCM
ODD	Overview, design concepts, and details
OEM	Original equipment manufacturer
PDI	Process-driven innovation
PET	Polyethylene terephthalate
PP	Polypropylene
PUD	Polyurethane dispersion
PVC	Polyvinyl chloride
RNP	Really new product

SKIN	Simulating knowledge dynamics in innovation networks
TPE	Thermoplastic elastomers
TÜV	Technischer Überwachungsverein
VCI	Verband der chemischen Industrie
VCM	Value Chain Marketing
VOC	Volatile organic compounds
UV	Ultraviolet

Mathematical Abbreviations

A	Amount of within-field knowledge
b	Big supplier's ratio
c	Capital
$C1_C$	Cost constant 1 in cooperative VCM
$C1_{NC}$	Cost constant 1 in noncooperative VCM
$C2_C$	Cost constant 2 in cooperative VCM
$C2_{NC}$	Cost constant 2 in noncooperative VCM
$Cost1_C$	Cooperative cost 1
$Cost1_{NC}$	Noncooperative cost 1
$Cost2_C$	Cooperative cost 2
$Cost2_{NC}$	Noncooperative cost 2
CV_C	Offered customer value in cooperative VCM
CV_{NC}	Offered customer value in noncooperative VCM
E	Expertise in communication
ECV_C	Expected customer value in cooperative VCM
ECV_{NC}	Expected customer value in noncooperative VCM
EM	Expected message
η^2	Eta squared
IC	Implementation costs
IT	Implementation time
$joint\,M$	Joint message
K	Knowledge field
m	(Value Chain) Marketing strategy
M	Message
MC	Marketing concept
MC^A	Marketing concept of the applicator
MC^S	Marketing concept of the supplier
MC^{SM}	Joint marketing concept
MS_{error}	Error mean square
n	Newness of innovation
N_A	Number of applicators
N_M	Number of manufacturers
N_S	Number of suppliers
o	Knowledge overlap

ω^2	Omega squared
$Partial\,\eta^2$	Partial eta squared
r	Innovation rate
S	Marketing success
SS_{effect}	Effect variance
SS_{error}	Error variance
SS_{total}	Total variance

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Part I
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Chapter 1
Introduction

1.1 Statement of the Research Problem and Relevance

Suppliers innovate in order to stay competitive in the global market and enhance their sales (see Cowan and Jonard 2009; Kashani 2006; Bartlett et al. 2004). However, they are often faced with big difficulties in marketing, i.e. a high resistance to their innovations (Jeannet 2006; Ram and Sheth 1989). This situation is typical for business-to-business (B2B) markets. In these markets, suppliers are confronted with the following problem: Demand for their industrial goods is ultimately derived from demand for the customers' products (Hillebrand and Biemans 2011; Kleinaltenkamp et al. 2007; Fern and Brown 1984). Due to suppliers' dependence on derived demand, their innovative materials have to be canalized through many stages in the value chain and need to be accepted and forwarded by many firms in the downstream direction.

To date, material suppliers usually approach the value chain by dealing with their immediate customers and essentially pushing their innovations into the value chain (Kleinaltenkamp et al. 2007). But immediate customers often have low incentives to adopt supplier innovations. The value associated with a supplier innovation is not always evident for suppliers' immediate customers. It becomes more obvious when materials get closer to their final application. As a result, immediate customers often prefer to wait until they receive strong signals from their customers indicating the need for an innovation.

To break through immediate customers' resistance, a small number of suppliers try to pursue Value Chain Marketing (VCM). They understand that "this narrow view, focusing on the nearest set of buyers, is insufficient for sustained competitive advantage" (Jeannet 2006, p. 14). Reinforcing this point, Mesak and Darrat (2003) as well as Jones and Ritz (1991) state that products that do not correspond to downstream customers' needs are not likely to succeed. Suppliers enlarge their target group beyond their immediate customers and address their downstream customers as well by pursuing VCM (Soroor et al. 2009; Gundlach et al. 2006;

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Skjoett-Larsen et al. 2003; Spekman et al. 1998; Cooper et al. 1997). This wider "customer horizon" (Hillebrand and Biemans 2011, p. 73) is based on the assumption that downstream customers greatly impact the supplier's marketing success since they have both the potential to benefit from supplier innovations and the market power to pull these innovations through the whole value chain (Pförtsch et al. 2008; Jeannet 2006).

In this dissertation, VCM is understood as the practice of influencing the entire value chain to succeed in marketing innovative products or services. It represents a marketing strategy which covers the entire marketing mix (product, price, place, and promotion) and thereby encounters the complexities of the value chain in which supplier firms operate. This marketing strategy requires a firm to have a deep and complete understanding of the value chain and its players in order to maximize marketing success (Jeannet 2006).

Surprisingly, the existing literature largely ignores the marketing problems of supplier firms. Hillebrand and Biemans (2011) point out that research merely deals with general observations in B2B marketing. Some authors discuss VCM on a macro level and investigate the general need for and a concept of VCM by describing marketing situations in B2B markets (Jeannet 2006; Kleinaltenkamp and Rudolph 2002; Rudolph 1989). Others focus on branding aimed at downstream customers. They use the term of ingredient branding (Rodrigue and Biswas 2004; Vaidyanathan and Aggarwal 2000; McCarthy and Norris 1999; Rao et al. 1999; Venkatesh and Mahajan 1997; Norris 1993, 1992). But ingredient branding is just one of many marketing activities when practicing VCM. The missing factor so far is an in-depth discussion and elaboration as well as an empirical explication and validation of the concept of VCM.

Therefore, the aims of this doctoral work are to exchange macro with micro level, to learn from examples in practice, to provide examples on how VCM can be done, to synthesize theoretical and practical know-how, and to develop guidelines for interested B2B practitioners.

Treading on relatively unexplored grounds, this thesis uses a multi-target research approach and connects VCM with the marketing of innovation. Exploring the importance of VCM in value chains and understanding the way of practicing and implementing VCM forms one of three major goals of this thesis. This involves three basic research questions:

- Is VCM a relevant and widely used marketing strategy?
- Which industries or final applications pursue VCM?
- How are the value chain and the general VCM process structured?

The first of these three questions aims to address the implementation of VCM in the business practice. The second question is particularly important to gain an overview of the industries in which VCM is a widespread marketing strategy to increase the success of supplier innovations. The aim of the third question is to study the specific characteristics of the value chain and the general way of stimulating demand in B2B markets.

After gaining a first understanding of the phenomenon, the goal is to unfold the black box of VCM by studying examples in detail. The aim is to create an understanding of key variables and their relationships. Based on this understanding, research hypotheses focusing on the critical variables for the supplier's marketing success are derived. Therefore, the second goal is to investigate the different strategic approaches to practice VCM and to analyze their effectiveness to increase the success of supplier innovations. This includes three main research questions:

- Which strategic approaches to practice VCM do exist?
- What is characteristic for these VCM approaches?
- Which factors seem to have an impact on the effectiveness of these VCM approaches?

The first two questions aim to understand differences in the way of stimulating demand in B2B markets. The third question is particularly relevant to identify critical factors for the supplier's marketing success to implement innovations across the value chain.

The final goal of this doctoral work is to compare the VCM strategies and to study systematically the effect of the identified factors for the supplier's marketing success. This involves another three major research questions:

- How does the marketing performance differ across the VCM strategies?
- How do the identified factors influence the supplier's marketing performance?
- How do these factors interact?

The first question focuses on the advantages of the VCM strategies. A systematic analysis of the impact of the identified factors for the supplier's marketing success follows with the second and third research questions.

Although VCM is mostly uncovered by secondary research, the phenomenon is often observed in the chemical industry. This industry is particularly characterized by a high innovation rate. Furthermore, chemical materials have to undergo several stages of processing or assembling until they arrive to their final destination. Their demand is thus of derivative nature.

1.2 Research Design and Approach

The research questions are studied empirically, analyzing different VCM projects. A multi-method design linking case study research and computational modeling is used for the purpose of this research. To refine the research with respect to content and procedure, the case study research is preceded by a pilot study (Ellram 1996). In this thesis, the computational method is called agent-based modeling. This methodological triangulation, defined as "the combination of methodologies in the study of the same phenomenon" (Denzin 1970, p. 297) helps to improve the accuracy and validity of the thesis by relying on data from more than one method (Yin 2009; McCutcheon and Meredith 1993; Meredith et al. 1989; Cook and Campbell 1979;

Jick 1979). Ultimately, it also helps triangulating the different findings to secure an in-depth understanding of the VCM phenomenon (Griffin 2012). In addition to methodological triangulation, data triangulation is used to overcome the problem of informant bias (Ellram 1996). This implies that multiple informants are interviewed and archival data are gathered to validate the results and provide a fuller picture of the business unit under study.

Due to the lack of prior research on VCM, the study consists of three phases. The first phase takes a rather broad approach to the topic by using a pilot study to confirm the importance of VCM in value chains and identifying relevant issues. The interviews cover firm demographics, value chain structures, the extent to which suppliers pursue VCM, the success and the general process of their VCM attempts, as well as the problems experienced in marketing their innovations via VCM. In the second phase, multiple case studies are used to focus on the VCM process in specific scenarios and explore the different strategic approaches to VCM. In each respondent firm, a recently finalized marketing and innovation project is selected and respondents are asked to discuss the VCM steps and the critical factors for the supplier's marketing success. In the first two phases, empirical data gathered from the real-world system are used and primarily analyzed in a qualitative way (Ellram 1996). The results are expressed verbally and help create an understanding of relations or complex interactions. The third phase continues to focus on the phenomenon of VCM, using an agent-based model to obtain data from numerous VCM projects and study the effect of the identified critical factors on the supplier's marketing success. The model is based on big amount of simulated data which "come from a rigorously specified set of rules rather than direct measurement of the real world" (Axelrod 1997, p. 3). Simulated data can use qualitative analysis, quantitative analysis, or a mixture of both. Compared to qualitative results, quantitative results are expressed in numbers.

1.3 Structure of Dissertation

This dissertation comprises five parts divided into nine chapters. Figure 1.1 illustrates the structure of the study. The first part gives an introduction with a concise outline of the research focus and the research approach.

The second part provides an integrative overview of relevant literature to sharpen the work's scope. It starts with Chap. 2 explaining the value chain, derived demand and the dominant marketing strategies to deal with derived demand, i.e. push and pull marketing. The following section concentrates on taking a closer look at VCM; more specifically, insights concerning precise definitions and differentiation from push and pull marketing are provided and the implementation of VCM is discussed. Next, Chap. 3 clarifies the term innovation and discusses how supplier innovations could be classified concerning their degree of newness. It then analyzes the challenges suppliers are faced with when marketing their innovations. This analysis helps to understand the dilemmatic situation in industrial value

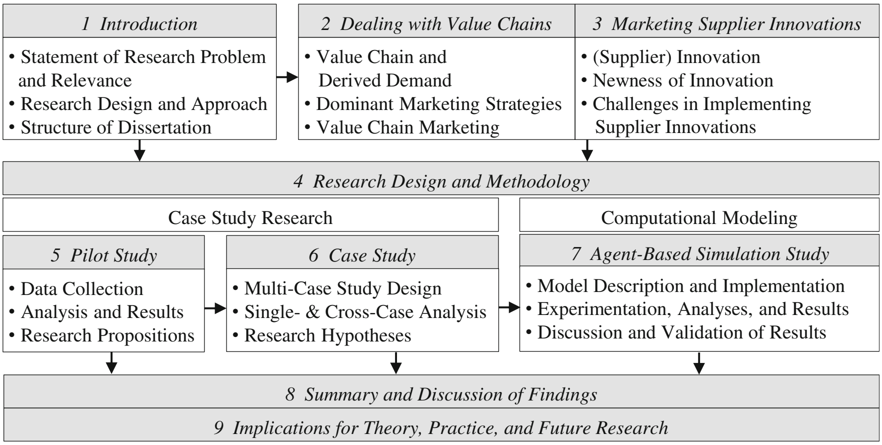

Fig. 1.1 Structure of dissertation

chains. Based on the theoretical part of this thesis, Chap. 4 describes the empirical setting in more detail. It first presents a conceptual framework for exploring the VCM phenomenon. Next, the combination of research methodologies with which to best approach the research questions is explained. Finally, the chemical industry as the empirical field of research is briefly outlined.

The third part discusses the first two main topics of this dissertation, namely exploring the relevance of VCM in value chains and unfolding the black box of VCM to understand the way of stimulating demand in B2B markets. To move into the field, Chap. 5 presents a pilot study analyzing the relevance of VCM as a promising strategy to increase the success of supplier innovations and studying the general VCM process. It describes the data collection process and the analysis of results. Finally, it concludes with a short discussion of the preliminary results and derives the research propositions that will be tested in Chap. 6. This chapter presents multiple case studies investigating the way of stimulating demand in more detail and identifying the critical factors for the supplier's marketing success. It first explains the case study design, the case selection, the data collection, and the rigor of the case study research. It then presents the five cases and the analysis of results. It ends with conclusions and implications for proceeding and finally derives the research hypotheses that will be tested in the simulation study.

The fourth part turns to the last topic, namely comparing the marketing performance of the different ways of stimulating demand in B2B markets and exploring the impact of the identified factors for the supplier's marketing success, which is investigated through an agent-based simulation (ABS). Chapter 7 outlines the simulation method. It first presents agent-based modeling (ABM) in marketing, the related work, and the appropriateness of ABM to simulate VCM. It then explains the model and its implementation as well as its verification. Next, it focuses on the design of experiment and presents the experimental results. It ends with a discussion and an interpretation as well as a validation of the simulation results.

The fifth part integrates the findings. Chapter 8 first provides a summary of the central findings. Limitations of the current work, delimitations, validity, and the scope of generalization are discussed in the second section of this chapter. Chapter 9 is the conclusion. It discusses implications for theory, for managerial practice, and for future research.

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Part II
Conceptual and Methodological Foundation

Chapter 2
Dealing with Value Chains

This provides an overview of relevant literature. It starts with explaining the central terms 'value chain' and 'derived demand'. After defining these terms, the chapter introduces the two dominant marketing strategies for dealing with derived demand, i.e. push marketing and pull marketing. It then compares the two strategies by discussing their advantages and disadvantages. Afterward, VCM is introduced and definitions used in the marketing literature are presented. Reflecting on the VCM topic also requires further discussion with respect to its practical implementation. Special attention is paid to the following aspects: (1) How to develop a clear understanding of the respective value chain? (2) How to customize marketing activities and tools to stimulate demand in B2B markets? (3) How to embed VCM in the day-to-day marketing operations of a supplier firm?

2.1 Value Chain and Derived Demand

The concept of the value chain was first introduced by Michael E. Porter (1985) with the firm-internal focus as the defining characteristic. A value chain can be simply defined as the chain of strategically relevant activities in a firm. At the industrial level, the flow of products or services from one firm to another creates links between them. Each firm adds value to the products or services. The links are called industry value chain or a value system (Porter 1985).

2.1.1 Supply Chain Versus Value Chain

Based on Porter's definition, Keith R. Oliver and Michael D. Webber coin the term of supply chain which is characterized by a wider scope, i.e. the integration of material and information flows from the raw material to the ultimate customer. The

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supply chain thus represents a “network of organizations that are involved, through upstream and downstream linkages, in different processes and activities that produce value in the form of products and services in the hand of the ultimate consumer” (Christopher 2005, p. 17). By contrast, the value chain covers all stages of suppliers from the point of origin of an innovative solution and all stages of customers up the point of the creation of an innovative product (Niemelä-Nyrhinen and Uusitalo 2013). The most distinctive characteristic is that a value chain also includes influencers (e.g. engineering consultants, industrial designers, intermediaries, or experts for complementary products) because they have an impact on the purchasing decision of the suppliers’ immediate and downstream customers.

2.1.2 Value Chain Used in this Dissertation

The value chain in this dissertation follows the explanation of Jeannet (2006). He defines the value chain as a system which “includes all industry participants, connected in a successive chain of added value, from raw material production to original equipment manufacturer (OEM), wholesaler, retail customer and in some cases recycling” (Jeannet 2006, p. 23). In contrast to the company-internal focus of Porter’s value chain, Jeannet (2006) describes the value chain as a macro business system and analyzes the entire industry as a whole including all upstream and downstream players. Figure 2.1 shows a rather simplistic industry value chain.

In defining the relevant stages of the value chain used in this dissertation, a fixed point of origin and an endpoint are selected (see Grunert et al. 2005). The point of departure is represented by a supplier firm which develops innovative materials. Next, the intermediate stage, i.e. the manufacturer, transforms these materials into a product and sells it to the endpoint, i.e. the stage of the end applicator. At this stage, the value of the supplier’s innovative materials becomes obvious. The stage of the manufacturer represents the supplier’s immediate customer and that of the applicator the supplier’s downstream customer. These ideas are summarized in Fig. 2.2. In the following paragraph, the relevant stages are explained in more detail.

- *Material suppliers* are placed in the upstream position of the value chain and represent firms providing materials or product inputs (Brun et al. 2010). They

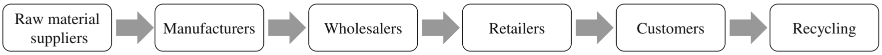


Fig. 2.1 Industry value chain (Jeannet 2006, p. 24)

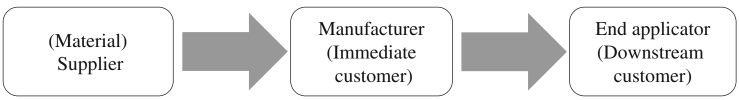


Fig. 2.2 The value chain used in this dissertation

sell their materials solely as an input to the applicator's final product. These products remain ingredients of the final product (McDowell Mudambi et al. 1997). Kotler (1991) defines these types of products as entering goods because they become a physical part of the finished products and include all manufacturing materials. Producers of coating ingredients, offering binders, pigments, solvents and additives, are an example for material suppliers.

- *Manufacturers* are the immediate customers of material suppliers and use the output of the suppliers as their input. These firms are typically manufacturers who transform materials into products to be sold to their own immediate customers. Packaging producers are one example of immediate customers. They use the output of different material suppliers, including suppliers of coating ingredients, to produce packages. They then sell the packages to other firms who need them for their final products.
- *End applicators* are the immediate customers to manufacturers and the downstream customers to material suppliers. Downstream customers can be built by a number of successive firms or simply by a single firm which produces final products to be sold to end customers (Kleinaltenkamp 2007; Kleinaltenkamp and Rudolph 2002; Rudolph 1989). Concerning the objective of this thesis, it is adequate to assume that there is only one firm acting as the downstream customer. This firm is called end applicator. Food processing firms are one example of end applicators because they use the packages produced by the manufacturer and thus indirectly use the coating ingredients from the material supplier.

The terms manufacturer and immediate customer as well as end applicator and downstream customer will be used interchangeably in this dissertation. The term supplier is also used to refer to material supplier.

Material suppliers create and offer products that pass through at least one but more often through a series of stages in the value chain and thus become part of the final product (Kleinaltenkamp and Rudolph 2002; Cox et al. 2001; Cox 1999; Fuss 1973). The demand for these kinds of industrial goods is "directly determined by the demand for the industrial customer's product" (Webster 1991, p. 10). In a nutshell, the demand for suppliers' materials is derived from the demand for the customers' products and, ultimately, the customer's customer demand (Hillebrand and Biemans 2011; Morris 1992; Fern and Brown 1984). This implicates that demand depends on the downstream buying decisions (Kleinaltenkamp 2007). Figure 2.3 graphically illustrates the concept of derived demand.

Fig. 2.3 Derived demand

Due to suppliers' dependence on derived demand, their materials have to be channeled through many stages in the value chain and need to be accepted and forwarded by many firms in the downstream direction. Therefore, a perfect understanding of the value chain is one of the challenges suppliers have to meet. Reinforcing this point, Hillebrand and Biemans (2005, p. 5) note that "truly market-oriented firms have a thorough knowledge of the entire value chain". Webster (1991) stresses that the nature and scope of B2B markets is wider and necessitates an understanding of both the nature of demand facing the customer and the customer's customer. The author further discusses that the need to analyze and to understand market activity at all stages between industrial and private customers is a key success factor of derived demand in B2B markets (Webster 1991). This can become quite complex if the supplier's output is used in a wide variety of final applications. In addition, a supplier's material is often indistinguishable from the final product. In turn, this significantly challenges a supplier's marketing approach to address the application market (Unger-Firnhaber 1996).

2.2 Dominant Marketing Strategies

Material suppliers are aware of the power and influence of downstream customers. Still, this awareness of derived demand effects does not bring change in suppliers' marketing programs automatically (Hillebrand and Biemans 2011, 2005). Some representatives of supplier firms surrender. They "accept derived demand as an inherent characteristic of B2B markets and feel that it is outside their control" (Hillebrand and Biemans 2005, p. 9). They consequently restrict their customer horizon to the nearest set of buyers and pursue push marketing (see Sect. 2.3.1). Meanwhile others genuinely try to deal with the consequences of derived demand. But instead of mapping the whole value chain, they focus on the downstream stages of the value chain they are a part of. This approach is called pull marketing (see Sect. 2.3.2).

In the following two sections, push and pull marketing are described. These two marketing strategies mainly differ in the role that the reseller plays as well as the basis of the predominant flow of influence (Webster 1991).

2.2.1 Push Marketing

One traditional and dominant marketing approach is push marketing. In this single-stage approach, suppliers aim exclusively at their immediate customers to induce them to carry an innovative product and promote it to target customers (see Kotler and Pförtsch 2006; Dowling 2004; Beacham 1986). Therefore, they usually do not consider the downstream stages of the value chain. Reinforcing this point, Fuss (1973, p. 10) notes that "little if any attention is given to the problem of what

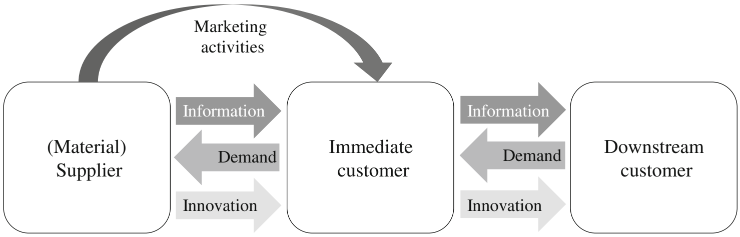


Fig. 2.4 Push marketing (Based on Dowling 2004)

happens to the material after the customer gets it". This seems to be logical because immediate customers are the firms which actually buy the supplier's products. As a result, the immediate customer plays a very active and critical role. Moreover, it has to be noted that push marketing is the only feasible strategy in many cases. Smaller firms, for instance, rely solely on push marketing as they need to spend their effort and resources in marketing effectively (Frazier 1999).

By pursuing push marketing, suppliers exclusively direct their marketing activities at immediate customers and rely heavily on personal selling and trade promotions, e.g. the salesforce, price incentives, and cooperative advertising (Beacham 1986). Their aim is to stimulate demand at all stages of the value chain, from material supplier to manufacturer of finished goods and from manufacturer of finished goods to end applicators (Dowling 2004; Gilliland 2004; Boone 1992; Webster 1991). Assael (1985) describes this procedure as using intermediaries to stimulate customer demand. Push strategies, should they be successful, must offer immediate customers monetary and/or non-monetary incentives to invest the time required to implement a supplier's product (see Unger-Firnhaber 1996; Webster 1971). Figure 2.4 illustrates the concept of push marketing.

2.2.2 *Pull Marketing*

In pull marketing, the second dominant marketing strategy for dealing with derived demand, suppliers no longer restrict their marketing activities to those who apparently make the procurement decision. By stimulating downstream customers, suppliers try to pull their innovative products through the entire value chain (Gerstner and Hess 1995). They bridge the gap to the application market (Unger-Firnhaber 1996) and gather valuable information regarding downstream customer needs. This supports a supplier's proactive innovations management (Wildemann 1993). As a result, the supplier is able to reduce his dependence on the manufacturer.

In this marketing strategy, the role of the manufacturer tends to be passive but the applicator's role becomes very active. The supplier tries to generate demand at the stage of applicators through extensive advertising and personal selling activities

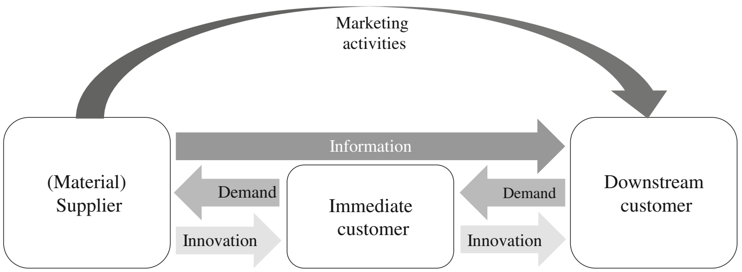


Fig. 2.5 Pull marketing (Based on Dowling 2004)

(Webster 1991). Thus, applicators become more informed about the available products and solutions that might be applicable to their business. Instead of pushing the product to immediate customers, suppliers make downstream customers request it. Webster (1971), for instance, indicates that a "vacuum" is created with the effect of pulling the product through the entire value chain from the material supplier to the applicator. The author further suggests that the manufacturers of finished goods have to stock and process the supplier's product because the applicator demands that they do so. With a pull strategy, the supplier does an end-run, circumventing the more direct value-chain actors, concentrating on those further down the value chain (see Morris 1992). The hope is that, if demand is stimulated down the value chain, it will pull sales through the intervening levels in the value chain (Boone 1992). Other authors state that the objective of a pull strategy is to establish a bottom-up demand base so that the immediate customer has little choice but to adhere to these demands and to place orders with the respective supplier (Backhaus 1992; Engelhardt and Günter 1981). As shown in Fig. 2.5, the demand is "passed back" through the whole value chain (Dowling 2004).

Consumer good firms are true experts in this field of marketing. They have much experience in getting their products pulled through the distribution system by influencing consumer preferences. Ingredient branding is a widely used marketing tool in this context. It describes a special type of alliance between two products, based on both firms' cooperation in designing and delivering the product, with particular emphasis on the possibility to recognize and identify the used components in the final product (see Kotler and Pförtsch 2006; Pförtsch and Müller 2006; Smit 1999). One well-known example for ingredient branding in business-to-consumer (B2C) markets is the Intel Inside® campaign. By stimulating demand for their processing chips among the end user, Intel exerts pressure on PC makers like Dell and IBM. They indirectly force them to use the Intel brand in order to satisfy the customer demand. In B2C markets, branding activities are directed toward the ingredient consumer, i.e. the stage of the user. This stage represents individuals, families, and households purchasing goods and services for their own consumption.

Pull marketing is however not only relevant for consumer products. This strategy receives increasing attention in B2B markets (see Norris 1992; Webster 1991). As in B2C markets, ingredient branding is a commonly used kind of product policy to stimulate demand at the downstream stage of a value chain (Hillebrand and Biemans 2005). Here, it describes a branding strategy between a supplier and a manufacturer in which the supplier's product becomes one of the components of the manufacturer's product (see Erevelles et al. 2008; Bengtsson and Servais 2005). Thus, branding activities in B2B markets are directed toward the ingredient user, i.e. the stage of the end applicator selling his products to industrial or institutional customers. Often cited examples are Makrolon®, Microban®, Teflon®, and Gore-Tex®. The mentioned examples show that ingredient branding is frequently applied in the chemical industry (see Kölbel and Schulze 1970; Schmitt 1969; Bergler 1968, 1963; Hertzberg 1963; Corey 1962).

2.2.3 Strategic Limitations of Push and Pull Marketing

In the next section, strategic limitations of both marketing strategies are presented. A pure push strategy does not correspond to the structural value-chain conditions today (Webster 2000). Unger-Firnhaber (1996) and Webster (1991) list some drawbacks of the push strategy for material suppliers. By solely relying on immediate customers, suppliers are faced with the problem of limited and distorted information and are also confronted with a loss of control over their product quality. More to the point, immediate customers withhold information about application trends and needs. They act as gatekeepers by controlling the types of information the supplier receives. Their aim is to remain the channel of communication between the supplier and the end applicator and thus stay in control of the business relationship. For that reason, supplier firms are unable to anticipate change and plan product improvements or new ideas. Due to isolation from the application market, suppliers are in a weak position in the value chain and operate anonymously. Even if they develop innovations, these rest with the intermediaries, i.e. the manufacturers, as the former are often unwilling to promote supplier innovations aggressively. That is why suppliers cannot demonstrate the importance of their product inputs for the final product. Manufacturers prefer to wait until they receive strong signals from their customers indicating the need for an innovation. They do not want to jeopardize their goal of efficiency. As a result, only standardized and highly substitutable materials that restrict suppliers' profits and margins are sold in the value chain. Instead of pursuing a proactive product innovations management, suppliers are forced to be reactive. Due to the absence of suppliers' contact with end applicators, the distance to the application market remains big. Suppliers have no chance to build long-term relationships with downstream customers which could reduce their dependence on manufacturers.

With pull marketing a bigger audience is targeted to appreciate a certain product. Such an effort makes it easier to convince the manufacturer to accept the supplier product because the downstream customer requires it. But this marketing strategy also has its downsides as Jeannet (2006) argues. The author discusses that pull marketing is a very cost-intensive strategy. By addressing a bigger target group, suppliers need sufficient and substantial amounts of financial resources for

Table 2.1 Disadvantages of push and pull marketing

Push strategy	*Pull strategy*
– Limited and distorted information – Loss of control over product quality – Weak position in the chain, anonymity – Innovations remain with manufacturers – Standardized and substitutable materials – Reactive innovations management – Distance to application market *– Dependence on manufacturers*	– Cost-intensive approach (sufficient and substantial amounts of financial resources for professional pull marketing) – Pure communication/promotion strategy (neglects product, price, and place aspect) – One-way communication – No personal interaction, no dialogues *– Primary demand stimulation*

professional pull marketing. Moreover, a pull strategy often describes a pure communication or promotion strategy. It relies almost entirely on advertising, but it neglects the product, the price, and the place aspect. Therefore, there is no instructional guideline concerning the type of product, the amount the downstream customers are willing to pay for it, as well as the method for distributing it to downstream customers. This strategy refers to a one-way communication without any personal interaction and dialogues. As a result, the supplier does not receive any feedback from the applicator and has no chance to demonstrate firsthand to the downstream stage how he can add value or reduce costs. In sum, pull marketing does not go beyond primary demand stimulation. Table 2.1 summarizes the disadvantages of push and pull marketing.

2.3 Value Chain Marketing (VCM)

Involving downstream customers like in pull marketing leads to another marketing strategy that addresses an even bigger audience. This strategy is called Value Chain Marketing (VCM) and describes the practice of influencing the entire value chain to succeed in marketing innovative products. It requires a firm to have a deep and complete understanding of the value chain in order to maximize marketing effectiveness (Jeannet 2006).

In this section, the VCM concept is illustrated and an introduction to different aspects is provided. Then, special attention is paid to the analysis of a value chain, specific marketing activities and tools, and the organization of VCM to explain how VCM can best be employed to strengthen a firm's attempt to implement an innovation.[1]

[1] Parts of this section are based on Lüthje et al. (2011).

2.3.1 Definition and Concept

The extant literature is inconsistent when it comes to define VCM and the ideas behind it (Kleinaltenkamp et al. 2009). Thus, different terms are used in this context. McCammon (1970) refers to the term 'vertical marketing system'. Ericsson (1976) declares 'vertical cooperation systems'. Arnott (1994) introduces the term 'leapfrog strategy'. Still, a common denominator of these concepts is not to focus merely on the immediate customer but also on the customer down the value chain (Kleinaltenkamp and Ehret 2006).

But VCM is not a trivial combination of push and pull marketing. It describes the harmonizing of push and pull marketing without placing the business relationship with immediate customers at risk (see Kleinaltenkamp et al. 2009; Kleinaltenkamp and Rudolph 2002; Unger-Firnhaber 1996; Rudolph 1989).

The first extensive study of the VCM concept was done by Rudolph in 1989. He introduces the term 'multi-stage marketing' and describes it as all marketing-related measures which are aimed at the subsequent market stages which follow one or several immediate customers (Rudolph 1989, p. 34). To deal with the consequences of derived demand, he argues that B2B sellers need to consider not only the next immediate customer in their marketing plans but also aim their marketing activities at subsequent stages. Based on several in-depth interviews with industry participants, this study analyzes in which specific business-political environment multi-stage marketing should be implemented for parts and components suppliers. Thus, the study elaborates critical influencing factors together with distinct strategic alternatives and practicable marketing instruments. Rudolph summarizes the pros and cons of multi-stage marketing, outlines the application requirements, describes the selection of the target stage, and compares different strategies.

The second study was done by Unger-Firnhaber (1996). This study combines in-depth interviews and a broad literature review. It determines the internal and external key success factors by which to implement VCM. It starts with the analysis and characterization of parts and components suppliers and their respective market features. It then proceeds toward specific challenges B2B suppliers face: Here, it attempts to answer whether VCM can, not only assist in overcoming said challenges, but also whether it can enhance a position in the marketing channel. Ultimately, the study provides suppliers with guidelines for the design and implementation process of VCM.

Afterward, a book was edited by Kashani (2006) to tackle emerging marketing problems that have transformed industries and to present fresh ideas that go beyond the traditional boundaries of marketing. In this book, Jeannet introduces the concept of VCM and with it a topic that examines opportunities for marketing downstream to the customer's customer. Compared to the previous definitions and discussions, Jeannet refers to a holistic marketing approach and focuses on supplier innovations.

VCM goes beyond traditional marketing, missionary selling, as well as primary demand stimulation (Jeannet 2006). It represents a holistic marketing strategy which covers the entire marketing mix and thus encounters the complexities of the value chain in which a firm operates. As mentioned before, the pull strategy is frequently limited to the promotional part of the marketing mix. The author uses the term VCM "to refer to the practice of influencing an entire industry value chain for the benefit of the marketing function" (Jeannet 2006, p. 22). The ultimate goal of VCM is to develop comprehensive marketing intelligence and to promote innovations across all levels of the value chain. To stay competitive in the market, B2B marketers have to cover a broader framework to analyze the chain. They "must understand not only the cost and revenue dynamics of its intermediate target buyer firms, but also the cost and revenue dynamics facing the buyers' buyers, from whose demand the demand of the immediate market is derived" (Narver and Slater 1990, p. 21). This mapping process requires a high degree of market orientation. Also, they should integrate influencers like procurement and engineering consultants, industrial designers, experts for complementary products, lawyers, or architects when mapping the value chain. Their special characteristic is to influence both the buying decision of immediate and downstream customers. They are well-informed on present upstream and downstream marketing projects and are open to innovative ideas. Furthermore, influencers establish relationships to manufacturers and applicators and are able to get them interested and to induce them to stimulate demand for supplier innovations. Ciba, a producer of specialty chemicals, addresses packaging designers for visual effects since they advise applicators like Nestlé on purchasing decisions on packaging components. By stressing the appeal of effect pigments like XYMARA™, packaging designers mediate between applicators and Ciba. They have a deep understanding of visual effects and color management, which supports branding as well as differentiation. Ciba realizes their power and starts directing marketing activities toward these influencers.

Instead of relying on just one marketing strategy, VCM comprises push and pull marketing equally and covers the whole marketing mix. It includes the kind of product, how it is promoted to customers in a value chain, the method for distributing products to customers, and the amount the customers are willing to pay for a product. The crucial point is that in VCM the adapted and tailored marketing activities of the push and the pull strategy complement each other and are incorporated into one universal marketing strategy (Kleinaltenkamp et al. 2009; Kleinaltenkamp and Rudolph 2002; Frazier 1999; Kunkel 1977). Therefore, VCM combines the advantages of push and pull marketing and moderates their disadvantages by synchronizing and harmonizing push and pull effects. Figure 2.6 illustrates the concept of VCM and is composed of Figs. 2.4 and 2.5.

Kleinaltenkamp and Rudolph (2002, p. 294) summarize the benefits of VCM as follows. First, VCM reduces the risk of substitutability of suppliers' materials or product inputs by demonstrating their importance for the end product. This means that suppliers no longer operate anonymously and address customers down the value chain directly. They create problem awareness among downstream customers by presenting the distinguishing features of their innovative products. As VCM allows a two-way communication, it increases the efficiency of the entire marketing mix. It implies that suppliers receive unfiltered feedback from downstream customers and the chance to better solve their problems in real time. As a result,

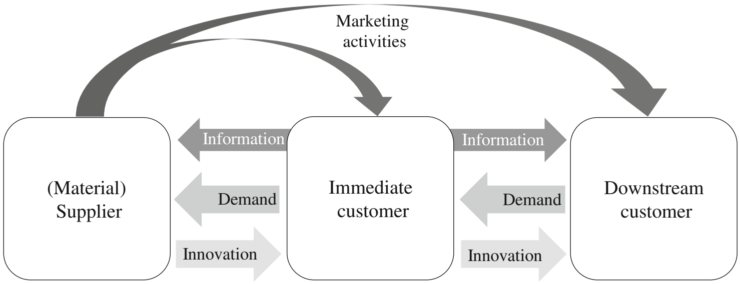


Fig. 2.6 Value Chain Marketing (VCM)

suppliers gather valuable market information and translate this information into product improvements or innovations. If suppliers succeed in positioning and differentiating their products in a favorable way, substitutability becomes less likely. By creating preferences at the stage of downstream customers, VCM assures suppliers' sales-political independence in the vertical production and distribution process. VCM allows suppliers to strengthen their position in a value chain and motivate downstream customers to invest in long-term partnerships. In consequence, suppliers are able to enhance control over different value-chain activities and anticipate fluctuations in demand more readily. Furthermore, VCM can stabilize the supply relationships across several market stages by establishing regular and personal updates on market trends and occasional visits. An additional benefit of VCM is that it helps to overcome market barriers, especially when marketing specialty goods because downstream customers greatly impact this kind of goods.

In order to target downstream customers, a supplier firm must offer added value. That is often the only way to create downstream customers' preferences. If supplier products have no positive differentiation value compared to available alternatives or competition, the prerequisite to pursue VCM is not fulfilled. This implicates that supplier firms would have no 'sales' arguments, and downstream customers would have no reason to prefer final products that contain a particular supplier's material. More to the point, products sold on price like commodities do not provide innovative attributes or distinguishing characteristics which can be promoted down the value chain. By contrast, specialty goods like coatings and sealants often provide a benefit for downstream customers by improving the performance of final products. Still, this benefit must be communicable to relevant end applicators. It implicates that only if they are convinced that using a specific supplier's material is particularly advantageous, they are willing to change their buyer behavior. To overcome this problem, suppliers can present prototypes, delivers samples, or results of product tests to demonstrate the benefit of their products. Also, suppliers have to ensure the identification of their materials at subsequent stages. This could be problematic because materials undergo several stages of processing or assembling until they arrive to their final destination. If the material of a particular supplier cannot be visually identified in the final product, it has to be detected based on its (chemical) composition or performance capability. Overall, suppliers must possess a minimum of market and marketing know-how when promoting their products via VCM. They must know at least the product flows and processes, the final application fields, the involved value-chain actors, and the supply relationships. If possible, suppliers should also ensure that the desired demand pull is not hampered by counterproductive activities of one of the subsequent stages (Kleinaltenkamp and Rudolph 2002).

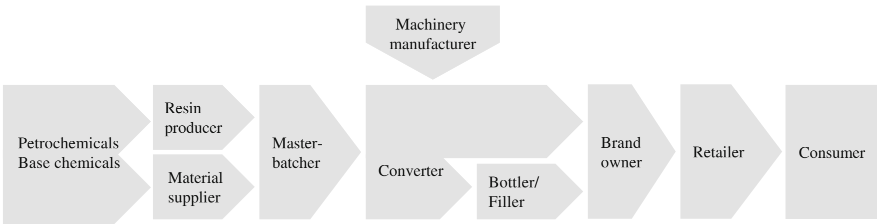
2.3.2 *Analyzing the Value Chain*

An important part of VCM is that suppliers analyze and properly understand the players and their relationships at each level, from industry developments and drivers up to the government regulations within the value chain they are a part of (Jeannet 2006). As Venkatesan (1992, p. 107) notes, “companies cannot get good at parts unless they know what the whole is about.” In the same way, suppliers cannot use VCM successfully unless they have a comprehensive understanding of the market beyond their immediate customer base (Unger-Firnhaber 1996). In fact, they have to monitor a wide range of final applications affected by a wide range of different factors (Hillebrand and Biemans 2011). This means that suppliers need to become experts of the customer’s business.

Data sources can be found both inside and outside the firm (see Jeannet 2006). Internal sources can include the firm’s business development plans, marketing and sales plans, and details about the strategy. External sources such as firm websites and analyst reports are useful to create a detailed industry map. Both sources provide information about the macro-environmental situation of a firm (e.g. government regulations, technological and ecological trends), the current market situation of a firm (e.g. application market, market trends, and competitive position) and the current internal situation of a firm (e.g. firm’s objectives and future plans). This information is highly relevant for suppliers pursuing VCM. With the help of this information, suppliers can offer innovative ideas or products to answer to government regulations, to correspond to customer specifications and needs, as well as market trends of an industry. Market research is certainly one of the most important and challenging tasks suppliers are faced with when pursuing VCM. They have to do market research at least one stage beyond the value chain where the VCM activities are concentrated (Unger-Firnhaber 1996).

Therefore, the first thing supplier firms have to do is to identify the players in the value chain, e.g. for packaging industry resin producer, material supplier, masterbatcher, compounder, converter, filler, machinery manufacturer, brand owner (e.g. Coca Cola), retailer (e.g. Tesco), and consumer. In many complex business systems, this can be described as a multi-stage system with several stages from supplier firms to the consumers. Secondly, they must separate the sub-industries like beverage packaging, food packaging, cosmetics and toiletries packaging and compare those with respect to their different elements and players. Thirdly, supplier firms have to map the various paths and access partners across the value chain for each sub-industry. Mapping means to identify the product and information flow as well as the relationships between the business systems. Fourthly, suppliers must define the system or industry boundary. For instance, finest luxury watches, such as those made by Patek Philippe, are part of the watch industry, as are less expensive models made by firms such as Casio (see Jeannet 2006). Fifthly, suppliers must characterize the role of each player. Five different roles are considered: gatekeepers, influencers, deciders, buyers, and users. Gatekeepers are the persons who regulate the flow of information concerning products and suppliers. Overly protective, masterbatchers often play this role and regulate or withhold information about packaging trends and brand owner needs. Influencers are the persons who do not make specific product or material choices, but impact on the type of decision made (Morris 1992). For instance, industrial designers constrain the decision process by creating design specifications which reduce the number of suitable alternatives. Deciders have the formal power to choose or approve the selection of the supplier or brand (Webster and Wind 1972). In many industries, the brand owner is the most powerful stage in a value chain and makes the buying decision. Buyers are the persons who actually negotiate the purchase. They have formal authority for selecting vendors and consummating the purchase. Users represent the persons who will use the final product. Figure 2.7 summarizes the different roles and players using the example of the packaging industry.

In summary, the key challenge in mapping the value chain lies in establishing intimacy with the various players to collect information about business relationships, supplier and customer relations, as well as processes and uses of products. Knowledge of the product flows and processes enables suppliers to create partnerships along the value chain. Also, suppliers need to be knowledgeable concerning customer needs and requirements. Without this knowledge they are not able to evaluate the customer value (see Unger-Firnhaber 1996). The next stage is to anticipate significant trends and changes of demand behavior.



Gatekeepers	*Influencers*	*Decision makers*	*Buyers*	*Users*
• Masterbatcher • Converter • Legal stakeholder • Retailer	• Machinery manufacturer • Material supplier • Resin producer • Retailer	• Brand owner – Engineer – Designer – Marketing – R&D	• Bottler/Filler • Brand owner	• Retailer • Consumer

Fig. 2.7 The roles and players in the packaging value chain (Based on Meier 2010)

After developing a full understanding of the customer's business, the supplier is able to build actual value propositions. But there is a difference between describing products in terms of their contribution to a customer's strategic issue and supporting products based on the customer's needs or expected benefits (Jeannet 2006). As stated by Jeannet (2006, p. 49), the needs and requirements have to be enriched with strategic customer insight focused on future market trends.

2.3.3 Practicing Value Chain Marketing

Practicing VCM involves more than speaking to downstream customers. Suppliers should conceive it as a strategic marketing approach that encounters the complexities of the value chain in which they operate. They must be able to simultaneously target multiple addressees with a coherent portfolio of activities (Flint 2004). Suppliers intending to practice VCM meet the challenging task to adapt and tailor their marketing mix, i.e. strive for the right elements to expose novel ways of stimulating a demand pull in B2B markets.

A supplier's product strategy is the first critical element of his marketing strategy. It deals with the design of products and services in line with customer requirements. There are several individual marketing instruments a supplier can use to support the success of his marketing strategy. Determining the product includes defining the use of the product, its features, advantages compared to competitors, benefits for customers, the brand, and value-added services.

If a supplier pursues VCM, a creative solution to present the use of his product is to develop a product form which allows the supplier to leapfrog the innovation barrier, e.g. granulate to directly supply the converter and thus leapfrog the masterbatcher. Hence, the downstream customer can test the supplier's innovative product without the legwork of the immediate customer. Furthermore, suppliers customize the product name. This name should express the customer benefit. An example: Ciba renames his oxygen absorber to Shelfplus O_2 as it could express special features and the end applicator's benefit—a long shelf-life. Another impulse can be to give the faceless product input an identity and thus an emotional appeal by using ingredient branding (see Sect. 2.2.2). A brand could be a crucial factor in the decision-making process of downstream customers because it stimulates demand and represents quality. For example, Carl Zeiss, a manufacturer of optical systems, industrial measurements, and medical devices, puts the slogan into action and make(s) it—the high quality lens for film and digital cinematography—visible. Ingredient branding allows them to create strong preferences for their optics. Suppliers of ingredient brands frequently promote their brands simultaneously to the manufacturer as well as to the final applicator (Luczak et al. 2007). Thus, simultaneous push and pull dynamics for the ingredient brand are created.

But ingredient branding is just one of many marketing activities in VCM. To connect the physical product with customer needs, supplier firms can offer value-added services like trainings, workshops, and consulting. Due to the high technical complexity of laser applications Oclaro, a supplier of optical and laser components and solutions, sustains an intensive exchange with their end users. The Oclaro sales and marketing team offers safety trainings for dealing with high-energy diodes with a low wavelength. The idea behind is to take advantage of a relaxed atmosphere in order to strengthen and emotionalize the customer relationship. Another example is Velux, a manufacturer of roof windows. The firm identifies architects as one major target group and arranges the lecture series “architects in the dialogue”. These workshops include various topics, e.g. lighting design and renewable energies, and involve architects to facilitate customized solutions.

In order to reduce uncertainty and respond to market requirements, suppliers should be driven by downstream customer information and pursue market research across all levels of the value chain. This implicates increased communication with downstream customers to receive inside information and translate this information into valuable product improvements and innovations. For example, National Starch, a producer of functional food starches, intensifies his market research activities with end users to be informed on downstream customers’ preferences and to resort to an immediate customer loyalty tool because immediate customers often spare their own market research. Similarity, Symrise, a supplier of flavor and fragrances, is heavily involved in an opportunity network with downstream customers and influencers (e.g. designers, scientists, and experts) to jointly develop innovative product concepts. With the help of market research, suppliers are able to offer quick solutions that fulfill customer needs and solve arising problems in the value chain. The aim is stimulating an intensive exchange along the value chain to build business partnerships and ensure market success (Hillebrand and Biemans 2011).

Next, supplier firms should try to determine the effect that a product can have on the different actors in the value chain and thus understand the value transformation. But how does the value (price) being extracted from immediate customers transform to customers down the value chain? How can the benefits for downstream customers be quantified and mirrored in the product price to immediate customers?

The following example will give an answer on these questions (see Jeannet 2006, pp. 48–49). A supplier firm tries to motivate a manufacturer of car seats to switch to an elaborated foaming system that is more costly per kilogram than the existing system. He argues that fewer kilograms of the material are needed because the new system offers a superior cushioning ability. But the car seat manufacturer rejects the supplier innovation because of the higher costs. Next, the supplier firm turns the discussion to adding strategic value by gaining cabin room and evokes interest at the downstream stage. This headroom gain measured in centimeters is of huge value to the OEMs. They are willing to pay a premium for space-saving seats offering with equal comfort. In summary, supplier firms should quote their prices in adjusted units used by downstream customers to increase the success of their innovative products.

Suppliers adopting VCM may also consider adjusting distribution channels. They can reflect on the possibility to establish technology partnerships in order to explore new, creative, and innovative solutions customized to the needs along the value chain. By having direct access to the innovative pipeline, suppliers may promptly provide an appropriate product to downstream customers and shape the relevant industry by anticipating future market trends.

The biggest challenge a supplier faces is the communication of innovations to the primary beneficiary. But the unavoidable fact is that communication efforts fail if the communicator presents an inappropriate message to his target audience. The only way supplier innovations can attract downstream customers is through transforming the marketing language and thus overcoming the distance to downstream customers. Without a doubt, face-to-face communication is unbeatable as it allows supplier firms to adequately portray complex product characteristics and associated added values. Furthermore, supplier firms can manifest their competency as a problem solver. By establishing personal and regular updates on market trends and occasional visits, supplier firms build trust, sympathy, and a sprouting relationship. Other options to present innovations are trade shows and exhibitions. For instance, Merck not only showcases at the European Coating Show (ECS) but also addresses the specific needs of the crucial actors in the value chain: immediate customers like paint manufacturers, downstream customers like brand owners (e.g. UVEX), and influencers like designers. Due to the different needs, each target group profits from a tailored product demonstration. Paint manufacturers demand information on technical performance, surface finish, color saturation, as well as mica and grain size distribution. Designers, in turn, are interested in user-oriented information and expect a demonstration of new styling possibilities in color and texture. To respond to different needs, each organizational unit in the firm must be closely connected to its assigned target group: the sales representatives to the immediate customers, and the marketing representatives to the downstream customers and influencers.

2.3.4 Organizing for Value Chain Marketing

Knowing how to practice VCM in theory does not increase the supplier's marketing success automatically. Unless VCM is embedded in the day-to-day marketing processes of a supplier firm, its potential will be limited (Jeannet 2006). Thus, a supplier firm has to organize for it.

The first element to embed VCM into the business practice refers to the necessity for staff that is able to think conceptually, to make strategic analyses, and to deal with customers on a senior executive level (see Jeannet 2006). It implies that the selected persons must have a deep understanding of the customer's industry. To engage new talents, a firm can use two different sources. First, it can profit from in-house talents staffed with conceptual tools and strategic thinking. Building on existing staff to target downstream customers is appropriate as a first step in VCM. Taking the sales force and marketing capacity at hand is a way of carefully using human resources to create first VCM success stories before heavily investing in other activities. Present sales representatives often have problems to learn the business of downstream customers. They are now asked not to sell but to do marketing instead. This business totally differs from the principles that govern the relationships with immediate customers. A sales engineer, for example, is used to sell label and folio printing machines to printing shops. Now, he is asked to identify the needs of nutrition companies, to understand the consumer retail business, and to identify important consumer trends—a completely new scope of duties. A supplier can deal with this problem by benefiting from the fact that he is part of a larger organization that includes business units with consumer marketing experience (see Hillebrand and Biemans 2011). An example: As part of the holding Maxinvest, tesa, a producer of self-adhesive product and system solutions, can benefit from the marketing experience of Beiersdorf. Second, a supplier can recruit external persons like executives from customer industries that might bring valuable insights. For instance, chemical firms engage retired production managers from downstream customers to improve their knowledge of consumer needs, to understand all facets of product and process flows, and to enrich discussions on capturing value (see Jeannet 2006).

The second element describes the required internal developments of a firm to successfully pursue VCM. This implies that supplier firms have to build large groups of senior managers at all levels that can master the use of strategic tools (Jeannet 2006). The challenge here is to build effective training for the largest possible number of employees. Only if the personnel become comfortable with VCM, this approach is a promising strategy for increasing the supplier's marketing success.

The third element refers to the fact that suppliers have to dedicate one business unit to the dealing with downstream customers' issues and the absorption of all relevant insights. Creating this task force enables suppliers to embrace downstream customers and become familiar with their business processes as well as the industry developments and drivers. In other words, suppliers gain access to critical information and will be able to reveal downstream customers' needs. It is critically important that supplier firms speak the language of downstream customers to get them interested and induce them to support and adopt innovations. The more the supplier inserts himself into the customers' business, the better the chances of innovation acceptance. An example: Ciba establishes the Market Platform Packaging and starts to focus its marketing activities on the value chain to brand owners as primary beneficiary. This new business unit is exclusively dedicated to manage the relationship with downstream customers and coordinate all activities targeting those customers across their entire product portfolio. The flavor and fragrances firm Symrise installs an international team dedicated to consumer research, National Starch builds up a new unit to manage their product brands, and the laser component manufacturer Oclaro builds up several task forces to open new end application fields for laser diodes.

But to change a firm's marketing strategy successfully, top management support as the fourth element is indispensable. As VCM challenges the traditional marketing approach, conflicts with existing structures and mindsets are most probable (Jeannet 2006). Only with strong senior executive support and commitment to transparent objectives can paralysis be avoided, which results from an inefficient matrix structure and unclear responsibilities of the business unit dedicated to the implementation of VCM. It is the task of the senior management to provide sufficient resources, financial as well as human resources, and to reinforce empowerment to the team.

In the previous chapter, a review of the marketing literature reveals VCM as a promising strategy to encounter the complexities of a value chain in which suppliers operate today, to strengthen their position in that value chain, and to reduce their dependence on derived demand and thus on manufacturers. VCM describes the practice of influencing the entire value chain to succeed in marketing supplier materials, especially innovative ones. However, a supplier's attempt to implement an innovation along the value chain usually involves several difficulties or challenges that should be introduced and explained in the next chapter.

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Chapter 3
Marketing Supplier Innovations

After framing the topic of VCM, this chapter will help to connect VCM with the marketing of supplier innovations. Firstly, the chapter offers definitions of the terms 'innovation' or 'supplier innovation' and 'newness of innovation' used in the business literature. Afterward, special attention is given to the challenges suppliers are faced with when marketing innovative products. In this context, three barriers have to be considered: The first barrier is the attitude of immediate customers toward supplier innovations (Sect. 3.3.1). The second barrier refers to the distance between the supplier and his downstream customers (Sect. 3.3.2). The third barrier describes the common knowledge required to communicate and interact with customers down the value chain (Sect. 3.3.3).

3.1 Innovation

Innovation is often considered as a dynamic source of strategic change by which a firm achieves positive results such as sustained competitive advantage (Salavou 2004). It is a complex construct that is described in a variety of ways (see Damanpour 1988). To date, there has been little consistency in the definition and conceptualization of innovation (see Garcia and Calantone 2002).

A review of the extant literature exposes that the study published by the OECD in 1991 offers the most appropriate definition. This definition is written by Freeman (1991) and is aptly summarized by Garcia and Calantone (2002, p. 112): "Innovation is an iterative process initiated by the perception of a new market and/or new service opportunity for a technology-based invention which leads to development, production, and marketing tasks striving for the commercial success of the invention". This definition highlights two main aspects. Firstly, the innovation process is characterized by the combination of two stages: (1) the technological development of an invention, and (2) the market introduction of the invention to final customers through adoption and diffusion. It implies that an invention can lead to innovation

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only if it has passed through production and marketing and is diffused into the value chain (see e.g. Makri et al. 2010; Ahuja and Lampert 2001; Smith and Barfield 1996; Freeman 1991; Layton 1977). The common theme for invention and innovation is value creation. Invention refers to a “unary” relationship where value is created mainly for the inventor, whereas innovation expresses a binary relationship between innovator and adopter (Runge 2006). Secondly, the iterative and interactive nature of the innovation process induces that an introduced innovation is always substituted by an improved version.

As mentioned, this study focuses on supplier innovations, i.e. innovations that are developed in the upstream part of a value chain. They have to be canalized through many stages in the value chain and need to be accepted and forwarded by many firms in the downstream direction. In fact, supplier innovations are science-driven inventions that include expertise across a broad range of disciplines (e.g. chemistry, material sciences, mechanical engineering). To promote this kind of innovation across the value chain, suppliers have to explain their benefit and functionality explicitly. This implies that they must offer concrete information, i.e. facts about products, processes, and markets, for the different players (Arora and Gambardella 1994). The type of information required depends among others on the newness of innovation. This concept is introduced next.

3.2 Newness of Innovation

In the adoption and diffusion literature, innovations are commonly classified with respect to their degree of newness. Still, there are several different approaches how to categorize it. A literature review reveals three main categorizations: dichotomous categorization, triadic categorization, and tetra-categorization (see e.g. Stockstrom 2009; Steinhoff 2006; Weise 2005; Lettl 2004; Garcia and Calantone 2002).

A widely-used dichotomization of innovations is to differentiate between ‘radical’ and ‘incremental’ innovations (see e.g. Kessler and Chakrabarti 1999; Balachandra and Friar 1997; Atuahene-Gima 1995). Another group of authors refers to ‘breakthrough’ (Rice et al. 1998), ‘really new’ (Song and Montoya-Weiss 1998), or ‘discontinuous’ (Anderson and Tushman 1990). A further group describes ‘adoption’ (Maidique and Zirger 1984), ‘variations’ (Normann 1971), or ‘routine’ (Meyers and Tucker 1989). But the problem is that “there is no consistent delineation on what is considered ‘high’, ‘moderate’ and ‘low’ degree of innovativeness and if that correlates to the categorization of ‘radical’, ‘really new’, and ‘incremental’ innovations or some other typology” (Garcia and Calantone 2002, p. 110). The situation becomes even more problematic because the named authors refer to different dimensions of newness. Furthermore, several studies only consider the technical aspect and neglect the dimension of market discontinuity (Ali 1994; Anderson and Tushman 1990). As aptly stated by Green et al. (1995), a pure dichotomous categorization of innovations alone is not sufficient. Table 3.1 summarizes the problems with a dichotomous categorization.

Table 3.1 Dichotomization of innovations (Based on Stockstrom 2009; Steinhoff 2006 and Garcia and Calantone 2002)

Study	Newness of innovation		Dimensions of newness
	Low	High	
Lee and Na (1994)	Incremental	Radical	Degree of difference from other products in technical characteristics or specifications
Atuahene-Gima (1995)	Incremental	Radical	Product newness to customers and firm
Balachandra and Friar (1997)	Incremental	Radical	Change in technology and product configuration
Kessler and Chakrabarti (1994)	Incremental	Radical	Type of work and degree of change
Rice et al. (1998)	Incremental	Breakthrough	Product performance
Song and Montoya-Weiss (1998)	Incremental	Really new	Market and technological newness
Ali (1994)	Incremental	Pioneering	Technological newness
Anderson and Tushman (1990)	Continuous	Discontinuous	Technological change
Yoon and Lilien (1985)	Reformulated	Original	Technological change
Maidique and Zirger (1984)	Adoption	True	Degree of technical content
Normann (1971)	Variation	Reorientation	Change of product dimension
Rothwell and Gardiner (1988)	Reinnovation	Innovation	Design newness
Meyers and Tucker (1989)	Routine	Radical	Market familiarity with the product class

The adoption and diffusion literature also offers more complex categorizations, i.e. triadic categorization and tetra-categorization. In this dissertation, special attention is given to the dimensions of newness and thus to the discussion from whose perspective the degree of newness is viewed and what is new (Garcia and Calantone 2002). The main focus is on the innovation studies that reflect on (1) the newness as perceived by the producers in the industry and (2) the newness as perceived by the target consumers. In the following paragraphs, an overview of relevant studies is provided. A summary is given in Table 3.2.

Kleinschmidt and Cooper (1991), for instance, suggest a triadic categorization of innovations and describe two dimensions of newness, i.e. market and technological newness. Finally, they present three types of innovation that differ in their degree of newness. The first type of innovation is new to both the firm and the consumer. Here, highly innovative products are developed that are new to the world. The second type of innovation is only new to the firm but not new to the target consumer. Thus, this type of innovation is characterized by a moderate degree of

Table 3.2 Triadic and tetra-categorization of innovations [Based on Stockstrom (2009), Steinhoff (2006) and Garcia and Calantone (2002)]

Study	Newness of innovation	Dimensions of newness
Triadic categorization		
Kleinschmidt and Cooper (1991)	Low innovativeness, moderate innovativeness, high innovativeness	Technological newness Market newness
Wheelright and Clark (1992b)	Derivative, platform, breakthrough	Product change Process change
Tetra-categorization		
Rumelt (1974)	Single product, dominant product, related product, unrelated product	Technological relatedness Market relatedness
Abernathy and Clark (1985)	Niche creation, architectural, regular, revolutionary	Market capabilities Technical capabilities
Gobeli and Brown (1987)	Incremental, technical, application, radical	Consumer's perception of newness Producer's perception of newness
Veryzer (1998)	Continuous, commercially discontinuous, technologically discontinuous, discontinuous	Product capability Technology capability
Ziamou (1999)	Incremental, functionality driven, technology driven, really new	Innovation functionality Consumer's input
Chandy and Tellis (2000)	Incremental, market breakthrough, technological breakthrough, radical	Customer need fulfillment per \$ Newness of technology

newness. The third type of innovation describes products that lead to minor improvements or repositioning of current products and thus refers to low innovative products.

Gobeli and Brown (1987) come up with a tetra-categorization of innovations and classify four types of innovations that differ in their innovativeness based on consumers' and producers' perceptions of newness. The first type of innovation, categorized as incremental product innovation, implicates little new technology and offers few new benefits to the consumer. The second type of innovation, categorized as technical innovation, does not offer many real new benefits to the consumer but is new to the industry concerning the technology embodied into a new product. Innovations that demand modifications in the manufacturing process are part of the second type of innovation (Wheelright and Clark 1992a). The third type of innovation, categorized as application innovation, is new to the relevant consumer and often involves changes in his usage behavior. Still, it does not implicate significantly new technologies. The fourth type of innovation, categorized as radical innovation, includes radical technologies and leads to major changes in existing consumption patterns.

Another tetra-categorization of innovations is done by Veryzer (1998). He defines two dimensions to explain the different levels of newness. The first dimension refers to technological capability and describes the degree to which the innovation includes new technologies. The second dimension is product capability and expresses the benefits of the innovative product as perceived by the consumer. After the definition of the dimensions, the author classifies four types of innovations. The first type of innovation, categorized as continuous innovation, includes products that offer the same benefits and apply the same technology. The second type of innovation, categorized as commercially discontinuous, is entirely new to consumers but disregards the technology aspect. The third type of innovation, categorized as technologically discontinuous, comprises radically new technologies while disregarding the aspect of the product benefit. The fourth type of innovation, categorized as technologically and commercially discontinuous, incorporates significant new technologies and enhanced consumer benefits.

Based on these aforementioned studies, Ziamou (1999) delineates two dimensions. The first dimension addresses the functionality of the innovation, i.e. what the product does. The second dimension refers to the consumer's input, i.e. what the consumer needs to do to obtain the expected functionality. These two dimensions determine the newness of the product to the consumer and lead to four different types of innovation: incremental innovations, functionality-driven innovations, technology-driven innovations, and really new products.

For the purpose of this thesis, the classification of Ziamou (1999) captures the essence of newness best. She distills the most relevant dimensions of newness by focusing on the product functionality and the efforts made to provide this functionality. Transferred to the VCM phenomenon, the first dimension refers to the functionality of a final product and the second dimension describes what a manufacturer, i.e. the intermediate stage of a value chain, has to do to provide the functionality expected by an end applicator.

Based on this consideration, the first dimension of newness describes the newness as perceived by the end applicator (i.e. the supplier's downstream customer) and reflects the product dimension of newness. It incorporates changes in the product functionality. Unlike manufacturers, end applicators are open to supplier innovations because they highly value the effect of new product functionalities. In other words, they are the main beneficiaries of supplier innovations. The second dimension of newness refers to the newness as perceived by the manufacturer and reflects the technical dimension of newness. This dimension expresses the changes in the manufacturing process of suppliers' immediate customers. These changes might involve changes in machinery, human resources, work practices, or a combination of these (OECD 1992). But changes in the manufacturing process may also trigger a loss of control if one production step is eliminated. An example: In the automotive value chain, a ready to use compound enables the production of high quality blends in a one step process. This, in turn, eliminates the coating process and thus reduces the manufacturer's sphere of competence.

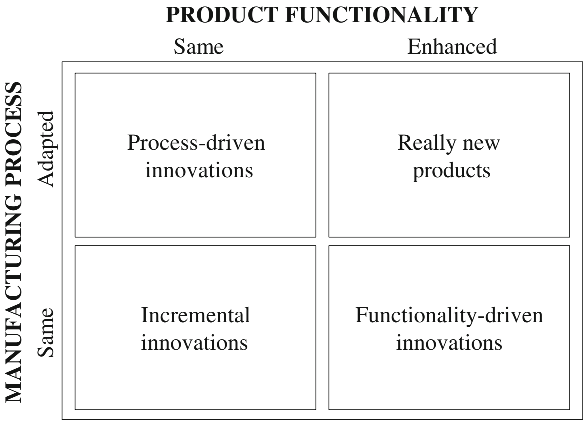

Fig. 3.1 Typology of supplier innovations [Based on Ziamou (1999)]

The combination of the product and technical dimension of newness determines how novel the supplier innovation is. Figure 3.1 shows a typology of supplier innovations. The first type of supplier innovation, labeled incremental innovation, refers to minor changes to present products. It offers the same benefits to the applicator and requires no changes in the manufacturing process. The second type of supplier innovation, labeled functionality-driven innovation, involves the implementation or trading of a new product with enhanced functionality but does not require changes in the manufacturing process. Products are adapted from other fields of application and involve the creation of a new field. The third type of supplier innovation, labeled process-driven innovation, comprises the adaptation of the manufacturing process of suppliers' immediate customers. While this type of innovation provides the same product functionality, it can offer other benefits to applicators, e.g. lower production costs, enhanced productivity and product quality, as well as resource efficiency. The fourth type of supplier innovation, labeled really new product, offers a new functionality to the relevant end applicator but also necessitates changes in the manufacturing process.

3.3 Challenges in Implementing Supplier Innovations

After developing an innovation, the supplier faces the challenging task of promoting and implementing it across the value chain. As mentioned, a supplier innovation is created at the beginning of a value chain. It is not easily implemented because it needs to be accepted and forwarded by many firms in the downstream direction of the value chain. Therefore, implementing supplier innovations via VCM results in three main adoption barriers: (1) the attitude of immediate customers toward supplier innovations, (2) the distance between suppliers and downstream customers,

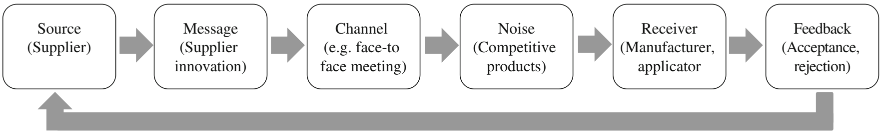

Fig. 3.2 Communication process [Based on Duncan and Moriarty (1998)]

and (3) the common knowledge required to communicate and interact with downstream customers. Without the necessary ingredient of communication, an innovation cannot be adopted and implemented (see Rogers 1986, 1983; Rothwell 1977).

In fact, communication can soften innovation resistance. In the context of marketing of innovation, communication describes an influence process. As discussed by Duncan and Moriaty (1998, p. 3), it is "the integrative element that helps tear down functional silos internally while closing the distance between the company, its customers, and other stakeholders". More to the point, Webster (1971, p. 16) reviews communication as the process of "WHO says WHAT to WHOM with what result". In the VCM context, the source embodies the supplier who originates and encodes the message. The message is the content and stimulus factor of the communication and refers to the innovation's performance, appearance, design, pricing, and where and how it is distributed (see Duncan and Moriarty 1998). Messages, i.e. symbols that are composed of information, are transmitted via different channels. A channel represents "the means by which a message gets from a source to a receiver" (Rogers and Shoemaker 1971, p. 251). Noise describes the diffuse accumulation of competitive innovative products and claims (Lasswell 1948). Therefore, it impacts the communication process (Duncan and Moriarty 1998). The receiver embodies the supplier's immediate customer, as well as his downstream customer, and decodes the message. The response of the receiver back to the source is the feedback as a central element of two-way communication (Duncan and Moriarty 1998). Figure 3.2 visually summarizes the process of communication in the context of VCM.

Persuasive communication incorporates messages that are appropriate for their audiences (see Duncan and Moriarty 1998; Krauss and Fussell 1991). A supplier's message needs to attract and hold the attention of a relevant immediate and downstream customer. To stimulate basic needs, it should include information which refers to common experiences of the supplier and his immediate and downstream customer. The way of satisfying the manufacturer's or applicator's needs must correspond to his current internal, market, and macro-environmental situation.

To transmit an appropriate and effective message, suppliers have to decide on the message content, the message appeal, the message structure, as well as the order of presentation. Basically, the effect of message content on the adoption of innovations has received some attention in diffusion research (e.g. Talke and Colarelli O'Connor 2011; Feldman et al. 2006; Cable and Graham 2000; Brown and Stayman 1992; Wilton and Pessemier 1981). For instance, Talke and Colarelli O'Connor

(2011) find that offering usability information (i.e. relative product advantage, compatibility, observability, and communicability) and financial arguments (i.e. cost mitigation, value-for-money, and profitability) in launch messages is highly relevant for market performance. Technical information (i.e. technical details, adaptability, and technical consequences) is counter-effective in impacting market performance. Only a small proportion of experts are able to fully understand and appreciate all technical details. The authors further suggest that usability information is of particular importance when promoting a highly innovative product. Financial details, in turn, become less important. In the context of VCM, value-chain actors seek out different types of information in making their adoption decision. Manufacturers (i.e. suppliers' immediate customers) request information that describes monetary details and technical consequences of implementation. By contrast, end applicators (i.e. suppliers' downstream customers) are mainly interested in product functionality details to evaluate the product's fit with their demand.

The effect of message content is related to the message appeal. In the marketing literature, most researchers differentiate between rational and emotional appeals (e.g. Liebermann and Flint-Goor 1996; Shimp 1990; Holmes and Crocker 1987; Nylen 1986; Ray 1982). Rational messages are primarily informative and therefore contain important details, facts and figures, i.e. price, technical features, and components. These messages are directed toward logic (Holmes and Crocker 1987). Emotional messages, in turn, advocate product functionality and aesthetics and try to link buying and application decisions to needs of potential customers (see Liebermann and Flint-Goor 1996). Regarding VCM, suppliers should rather transmit rational messages when addressing their immediate customers and emotional messages to directly contact their downstream customers. This will drive immediate and downstream customers' evaluation of supplier innovations and thus their likelihood of acceptance.

Besides the message appeal, the sender needs to structure the message, i.e. the way the message is composed. Here the question arises: whether the message should include supporting and opposing arguments, i.e., two-sided arguments, or should stress the favorable points, i.e. one-sided arguments (see e.g. Kao 2012; Eisend and Küster 2011; O'Keefe 1999; Crowley and Hoyer 1994; Allen 1998, 1991). Allen (1991), for example, finds that one-sided arguments are more effective with audiences who are initially in favor of the attitude conveyed by the message sender. The author further suggests that two-sided arguments are more effective with receivers who are initially opposed. With respect to the VCM phenomenon, one-sided arguments will be more effective when addressing downstream customers. They are relatively open to supplier innovations because they highly value the effect of new product functionalities. On the contrary, one-sided arguments will be more effective to convince immediate customers. They are often opposed to supplier innovations and prefer to wait until they receive strong signals from their customers indicating the need for an innovation. Their aim is to not place their goal of efficiency at risk.

Another structural feature of persuasive messages is the order of presentation and thus the question of which argument should be presented first in the communication (Webster 1971). There is a distinction to be made between climax and anticlimax order (O'Keefe 2002; Webster 1971; Hovland 1957). In the climax order, the most important arguments are presented last. If the communicator chooses the anticlimax order, he or she offers the most important arguments first. Webster (1971) suggests that an anticlimax order should be selected if the audience is initially disinterested and has to be motivated to listen, while the climax order is more effective if the receiver already shows some interest. Transferred to VCM, suppliers should select a climax order to interact with applicators and an anticlimax order to communicate with immediate customers.

3.3.1 Attitude of Immediate Customers Toward Supplier Innovations

A recurrent topic in the literature describing individual acceptance of innovations is that acceptance is based on perceived beliefs and affectations toward a particular innovation (e.g. Frambach and Schillewaert 2002; Meyers et al. 1999; Davis et al. 1989; Tornatzky and Klein 1982). These cognitive schemas are reflected in an individual's attitude toward the innovation (see Frambach and Schillewaert 2002; Le Bon and Merunka 1998; Triandis 1971; Rosenberg and Hovland 1960). Innovations mean change to customers, i.e. the disruption of established routines (Ram 1987). The resistance to change, i.e. the behavior aimed at maintaining the status quo, is a typical customer response to not place defined goals at risk (Kleijnen et al. 2009; Laukkanen et al. 2007; Woodside and Biemans 2005; Holak and Lehmann 1990; Ram and Sheth 1989).

Regarding industrial value chains, manufacturers are often characterized by an antagonistic or dismissive attitude toward supplier innovations. They do not want to jeopardize their goal of efficiency and thus represent the most likely source of innovation resistance (Hillebrand and Biemans 2011; Kleinaltenkamp and Rudolph 2002; Unger-Firnhaber 1996; Rudolph 1989). Innovation resistance refers to a special case of general resistance to change (Ram and Sheth 1989; Sheth 1981).

In the VCM context, Rudolph (1989) discusses the resistance of a manufacturer against using a specific innovative product of a supplier (Rudolph 1989). The first reason for this type of resistance is the lack of a strong incentive. This implies that a manufacturer perceives no added value when using a specific material of a supplier. Ram and Sheth (1989) describe this reason to resist as value barrier. It refers to the monetary value of a supplier innovation and arises if a supplier innovation does not offer a strong performance-to-price value compared to substitutes. In other words, there is no incentive for a manufacturer to change because of the poor relative advantage from his perspective.

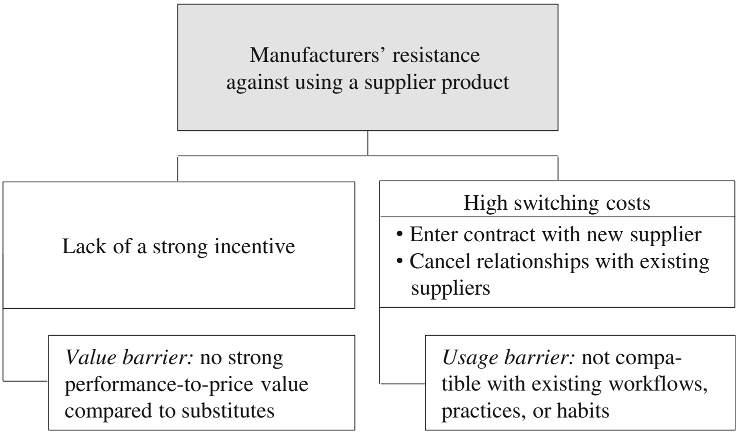

Fig. 3.3 Manufacturers' resistance against using a supplier product

The second reason to resist a supplier product is that a manufacturer fears high switching costs when implementing it. The problem is that a manufacturer already has strong relationships with competing suppliers and appreciates the routinized interaction processes (Rudolph 1989). By adopting a new supplier material, a manufacturer is often forced to cancel contractual arrangements with current suppliers and enter a contract with a new supplier. But this is in conflict with the manufacturer's tendency to strive for consistency and status quo (Sheth 1981). By collaborating with a new supplier, a manufacturer has to deviate from daily routines (see Herbig and Day 1992; Ram and Sheth 1989). He must learn new skills or alter long-ingrained routines to get familiar with the new supplier and his product. Moreover, quality control needs to be adjusted and employees in production should be trained. Figure 3.3 summarizes the resistance of a manufacturer against using a specific supplier product.

To break through immediate customers' innovation resistance, suppliers pursue VCM. They increase their marketing efforts directed at downstream customers to create a strong demand pull. But manufacturers try to undermine the supplier's marketing attempt. The main reason for this type of resistance is based on the manufacturer's perception that a supplier's VCM strategy counteracts his own strategy (Rudolph 1989). A manufacturer is usually not interested in pushing supplier products. He only aims at presenting his own product. Assuming that a supplier creates strong demand pull with the help of VCM, the manufacturer feels pressured into buying and converting supplier products and thus risks his autonomy in decision-making. His ultimate goal is to control the selection of supplier materials (Hillebrand and Biemans 2011). Likewise, a manufacturer fears the disclosure of confidential information, which in turn corresponds to the loss of strategic competitive advantages. In particular, smaller manufacturers are skeptical toward the usage of VCM since they fear that big suppliers might attempt to absorb them in order to improve their power position in the value chain.

However, the presence of manufacturers' resistance does not render a supplier's VCM strategy impossible (see Unger-Firnhaber 1996; Rudolph 1989). In order to deal with the dismissive attitude of a manufacturer, a supplier has to examine how strongly and persistently opposed the immediate customer base is to a supplier product or VCM strategy.

3.3.2 Distance Between Suppliers and Downstream Customers

In contrast to manufacturers, suppliers' downstream customers are predominantly open to supplier innovations and the VCM strategy. However, the big challenge complicating interpersonal interaction is the perceived distance between suppliers and downstream customers. This distance is based on the supplier's and applicator's position in an industrial value chain. Suppliers are placed in the upstream part of a value chain and represent firms focusing on science-based areas such as the chemical industry. Applicators are placed in the downstream part of a value chain and serve the application market, i.e. the end users. Thereby, suppliers and applicators are rooted in different disciplines and their daily routines are determined by totally different business activities. In other words, suppliers and applicators are characterized by industry-specific skills, competences, and expertise.

While most suppliers recognize the important role of downstream customers, only few suppliers look beyond their immediate customers and are actually capable of communicating smoothly with them (Hillebrand and Biemans 2011). Therefore, communication is limited due to perceived distance between communication partners. To overcome the distance to applicators, suppliers need to gather in-depth and up-to-date information about downstream customer needs and unfamiliar application markets. This, in turn, requires substantial resources and a direct access to customers down the value chain. Without such additional information, problems in communication occur due to inappropriate supplier messages. This implies that suppliers often lack the ability to perform well the collection and combination of information to transmit the added value of an innovation. As a result, the applicator, i.e. the receiver of the supplier's message, decodes the message but assigns another meaning to it because of different reference frames. A reference frame expresses the shared field of experience that describes a value chain or some part of it and finally decides on the opportunity for communication between suppliers and applicators (Webster 1971). If the communication partners only share a small field of experience, the perceived distance is an insurmountable obstacle and hinders the communication. These ideas are summarized in Fig. 3.4.

Besides similar reference frames, the transmitted information to end applicators must be meaningful to them to reduce the existing communication distance. This

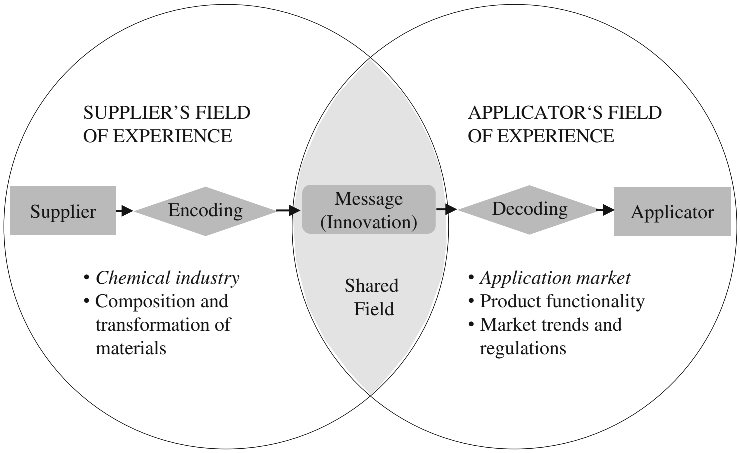

Fig. 3.4 Communicators' fields of experience [Based on Webster (1971)]

implies that the supplier's message conveys a significant downstream value and thus causes some action by the end applicator. The value term is mainly used to refer to the utility that the end applicator derives from a focal supplier innovation (Moenaert and Souder 1996). But the problem is that downstream customers often lack the expertise to evaluate the value of supplier innovations. In other words, the supplier's value proposition differs from that of the applicator. One of the earlier examples can be used to explain the differences in value proposition (see Sect. 2.3.3). A supplier of polyurethane materials offers a new foaming system for use in car seats. He tries to convince an OEM by stressing the main benefit from his perspective: using fewer kilograms of a material due to a superior cushioning ability. Unfortunately, this sales argument does not correspond to the value expected by the OEM. He wants to offer an additional benefit to his customers, i.e. car drivers. Thus, the supplier argues that a few centimeters in cushion height are equivalent to gaining interior headroom. This, in turn, represents the main benefit from the perspective of the OEM (see Jeannet 2006).

Sometimes, downstream customers are able to assess the value of supplier innovations by establishing specialized units staffed by experts (Hillebrand and Biemans 2011). In order to understand messages about e.g. food packaging solutions, an expert with a university degree in chemistry and work experiences in the field of packaging manufacturing helps applicators to interact with suppliers. In this way, the differences between the communication worlds of suppliers and applicators are diminished and the risk of misunderstanding is decreased. Reinforcing this point, Weigand (1999, p. 766) states that "communication will function all the easier, the less differences there are".

3.3.3 Common Knowledge to Interact with Downstream Customers

In reality, the source of the message, i.e. the supplier, is usually quite heterophilous to the receiver of the message, i.e. the applicator (Rogers and Shoemaker 1971). Heterophily is the opposite of homophily and refers to the degree to which communication partners are dissimilar with respect to certain characteristics (Rogers and Kincaid 1981; Rogers and Bhowmik 1971). The interlocutors' knowledge base is one of these characteristics.

A firm's knowledge base refers to the set of knowledge a firm has "demonstrated familiarity with, or mastery of", as described by Ahuja and Katila (2001) in their influential paper. Citing Kim and Kogut (1996), the authors further describe the knowledge base or portfolio as "the distinct elements of knowledge with which the firm has revealed a relationship". The knowledge bases of firms are located at different points in some underlying knowledge space, i.e. the value chain (Cowan and Jonard 2009). Typically, different actors possess different knowledge bases due to their position in the value chain. In the context of VCM, a distinction between three types of knowledge bases has to be made: science-driven or analytical knowledge base, engineering-driven or synthetic knowledge base, and application-driven or symbolic knowledge base (see Asheim 2007).

The science-driven or analytical knowledge base is found in industrial value chains where innovations are developed. Typical examples are biotechnology and nanotechnology. By creating new knowledge, this type of knowledge base often leads to scientific discoveries and technological inventions. Important activities in this context are basic and applied research as well as systematic development of products and processes (Asheim 2007). For instance, suppliers of coating ingredients operate in a science-based area. They have special know-how in the field of chemical composition, structure, and properties of substances and ingredients. To create innovative materials, they typically have their own R&D department but also cooperate with universities and other research organizations.

The engineering-driven or synthetic knowledge base is found in industrial value chains where innovations are converted. Typical examples are specialized advanced industrial machinery and production systems. Regarding the VCM phenomenon, manufacturers (i.e. suppliers' immediate customers) are characterized by an engineering-driven knowledge base. They are mainly oriented toward the efficiency and reliability of supplier solutions, or the practical value of final products from the perspective of their customers (Asheim 2007). An example: Manufacturers of plastic packaging are experts in the field of formulation and conversion of materials, and focus on the physical production process and the testing of final solutions.

The application-driven or symbolic knowledge base is found in industrial value chains where the value of supplier innovations becomes obvious. This type of knowledge base is associated with the functional and aesthetic attributes of final products as well as the creation of designs and images (Asheim 2007). Here, the

Table 3.3 The three knowledge bases [Based on Asheim (2007, p. 227)]

	Science-driven knowledge base	Engineering-driven knowledge base	Application-driven knowledge base
Value-chain actor	Supplier (e.g. supplier of coating ingredients)	Manufacturer (e.g. packaging manufacturer)	End applicator (e.g. food processing firm)
Value-chain position	Upstream stage	Intermediate stage	Downstream stage
Role in innovation process	Creation of innovation	Processing of innovation	Final destination of innovation
Knowledge focus	Importance of scientific/chemical knowledge	Importance of technical/applied knowledge	Importance of product-related/user knowledge
Business focus	Chemical composition, structure, and properties of substances and ingredients	Conversion and testing of materials/solutions, physical production process	Functional and aesthetic attributes of final products, end user needs and application market trends
Purpose	Newness and effectiveness of substances and ingredients	Efficiency and reliability of new solutions	Practical utility and user-friendliness of final products

physical production process is less important. Concerning VCM, end applicators (i.e. suppliers' downstream customers) are characterized by an application-driven knowledge base. They are mainly oriented toward a deep understanding of their application field to fulfill end user needs and expose market trends. Food processing firms, for instance, specialize in the domain of functionality and aesthetics of final products. Their aim is to protect the packaged content and improve the visual attractiveness of their products.

To reduce the distance in knowledge space, suppliers, manufacturers, and end applicators already have or try to acquire some knowledge in the surrounding fields. A supplier, additionally gains some applied or technical as well as product-related or user knowledge. An applicator strives for some scientific or chemical and technical know-how to fully understand the benefit of the final product. Due to his position in the value chain, a manufacturer often possesses chemical and product-related know-how. Sometimes, he acts as a mediator between supplier and applicator. Table 3.3 summarizes the main differences of the three knowledge bases.

To communicate smoothly, suppliers and downstream customers must continually appeal to their common grounds or shared knowledge bases in the form of language, shared meaning, or mutual recognition of knowledge domains (Lane and Lubatkin 1998; Grant 1996; Cohen and Levinthal 1989; Isaacs and Clark 1987; Clark 1985; Clark and Murphy 1982; Clark and Marshall 1981). This common ground helps to develop and transfer messages that are appropriate and comprehensible to the target audience (see Fussell and Krauss 1989). The extent of knowledge communication partners share varies significantly. If they overlap in their knowledge bases, they are familiar with similar 'know-whats', i.e. the semantics and the challenges of a specific information domain, and similar 'know-hows', i.e. an understanding of how the semantics and the challenges are causally linked (Lubatkin et al. 2001).

Concerning the value chain used in this thesis, there is a high degree of overlap, if the supplier and the applicator share knowledge in the chemical, the technical, as well as the product-related field. Schoenmakers and Duysters (2006) and Ahuja and Katila (2001) define the overlap of two firms' knowledge bases as the intersection of their knowledge bases. In principle, there is a close relationship between knowledge overlap and communication effectiveness (see Wu and Keysar 2007; Alavi and Leidner 2001; Fussell and Krauss 1989; Clark 1985; Rogers 1983; Clark and Marshall 1981). As shown by Fussell and Krauss (1989), the more closely the source's knowledge base overlaps with that of the receiver in the domain relevant to a message, the smoother the communication will be. They further suggest that failures in communication partially occur due to a source's inability to correctly evaluate the receiver's knowledge base, either because they lack information about it, or because of mistakes in their mental processes. A detailed discussion of further empirical findings on the topic of knowledge overlap and innovation performance will be provided at the end of Chap. 6 when deriving research hypotheses.

The relevance of the actors' knowledge bases and thereby the information embedded in the messages is determined by the newness of the supplier innovation marketed. For example, functionality-driven innovations call for product-related information (i.e. information about a product's functional and aesthetic attributes, underlying components, features, specifications, advantages compared to competitors, and value-added services). To transmit this kind of information, suppliers should be familiar with the applicator's business. Process-driven innovations, in turn, require technical information (i.e. technical details, adaptability, and technical consequences of the adoption). In view of that, suppliers must have a comprehensive understanding of the entire manufacturing process. The marketing of really new products entails product-related as well as technical information. Therefore, suppliers need to know the manufacturer's and the applicator's business. If the supplier as the source of the message is unable to offer the information required in a particular situation, the receiver will be less motivated to seek further information and this may lead to higher innovation resistance. Besides the relevance of information, the persuasiveness, credibility, and informativeness play a critical role in communication effectiveness. If the supplier's propagation mechanism is less convincing, less credible, and less informative, the receiver will be indifferent to the supplier's message and thus the innovation (Ram 1987). This may then also lead to higher innovation resistance.

In the previous chapter, the challenges suppliers are faced with when marketing their innovative materials are elaborated. The implementation of supplier innovations is often delayed or hindered by suppliers' immediate customers. They show a dismissive attitude toward supplier innovations because they do not want to place their business relationships with downstream customers at risk. To break through immediate customers' resistance of innovation, suppliers frequently use VCM even if they have to meet the challenging task of reducing the perceived knowledge distance to end applicators.

A literature review reveals that the extant research on VCM is predominantly theoretical with little effort devoted to empirical explication of the phenomenon. Questions like ‘Which strategic approaches to practice VCM do exist?’, ‘What characterizes them?’ and ‘Which factors have an impact on the effectiveness of these VCM approaches?’ appear to be lacking from the research on VCM so far. Thus, a more in-depth discussion of VCM is needed. In the next chapter, a more structured approach to detailed research questions will be developed in order to build a basis for a thorough empirical investigation of VCM.

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Chapter 4
Research Design and Methodology

Little is known about the design and implementation process of the VCM strategy used to promote and implement supplier innovations. Therefore, this research is initially exploratory and necessitates qualitative methods. A collection of field-based data will serve as an introduction to the VCM phenomenon. Accordingly, the research objective is not only to identify key constructs that influence the performance of VCM but also to develop a deep understanding of why identified constructs might be relevant when implementing supplier innovations along the value chain (Eisenhardt 1989).

In the following chapter, the object of the study and the method of data collection will be clarified. Moreover, a conceptual framework for exploring the VCM phenomenon will be presented. Alongside this framework, a more detailed set of research questions will be provided. Thereafter, the combination of research methodologies with which to best approach the central research questions will be explained. Finally, the empirical field of research will be briefly outlined.

4.1 Conceptual Framework and Detailed Research Questions

First, a conceptual framework is developed in order to structure the research. The underlying proposition of the research focuses on a supplier's marketing attempt to promote and implement innovations along the value chain via VCM. This attempt is closely tied to the supplier's marketing result (i.e. acceptance or rejection). The relationship is shown pictorially in Fig. 4.1.

Based on the theoretical part of this study, three major constructs that seem to be relevant to understand the result of a supplier's marketing project in a value chain are suggested. As depicted in Fig. 4.1, the first construct to the framework deals with the question of the value-chain actors that are involved in a supplier's attempt

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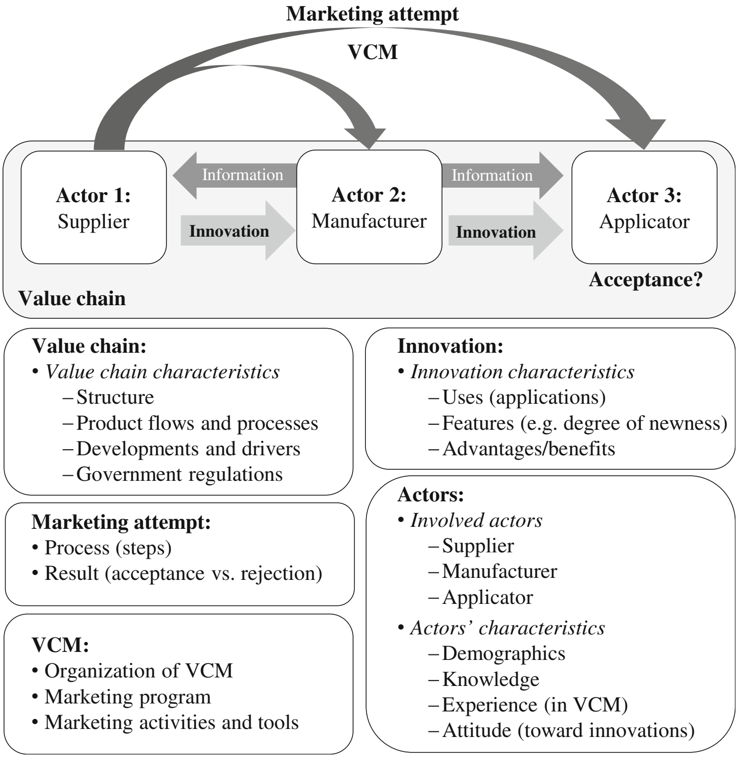

Fig. 4.1 Conceptual framework of VCM

to promote and implement innovations along a value chain. As discussed in Sect. 2.1, the group of involved actors includes the supplier, the manufacturer, and the end applicator. The supplier provides innovative materials or product inputs. The manufacturer transforms these materials into products, which in turn are sold to the end applicator. In fact, these three actors possess different characteristic values such as their attitude toward innovations and their knowledge base which depend on their position in the value chain. As discussed in Sect. 3.3.1, manufacturers are characterized by an antagonistic or dismissive attitude toward supplier innovations. By contrast, applicators are predominantly protagonistic toward supplier innovations (see Sect. 3.3.2). Regarding the knowledge base, each value-chain actor focuses on a specific field (see Sect. 3.3.3). The supplier mainly has special know-how in the field of chemical composition, structure, and properties of substances and ingredients. The manufacturer is primarily an expert in the field of formulation and conversion of materials while focusing on the manufacturing process and the testing of materials. The applicator generally specializes in the domain of product functionality and aesthetics. He focuses on the final product application and the end user trends.

The second construct, a supplier innovation, focuses on the product's uses, its features, its advantages compared to competitors, as well as its benefits for customers and customers' customers. This type of innovation is developed in the upstream part of a value chain and has to be accepted and forwarded by many stages (see Sect. 3.1). Supplier products are often applied to more than one field. As a function of application field, supplier products must satisfy different customer needs and thus offer different benefits.

The third construct to the framework outlines VCM as a supplier's marketing strategy, the analysis of the value chain, the customizing of the marketing activities and tools, and the organization of VCM. As discussed in Sect. 2.3.1, VCM represents a holistic marketing strategy which covers the entire marketing mix (product, price, place, and promotion) and matches the complexities of the value chain in which a firm operates. A central part of VCM is that suppliers analyze and properly understand the players and their relationships on each level, the industry developments and drivers, as well as the government regulations (see Sect. 2.3.2). Next, supplier firms intending to practice VCM will need to tailor their marketing mix, i.e. strive for the right marketing elements to expose novel ways of stimulating a strong demand pull in B2B markets (see Sect. 2.3.3). As a final point, suppliers have to organize for VCM by considering four critical elements: sourcing the talent, adapting the firm's mindset, forming dedicated organizational units, and gaining the top management support (see Sect. 2.3.4).

The supplier's marketing attempt to promote and implement an innovation takes place within a value chain. This chain is characterized by a specific structure, product flows and processes, as well as developments and drivers. Moreover, suppliers must meet legal and regulatory constraints. These constraints are divided into economic and social regulations (Morris 1992). Economic regulations include customer-sensitive areas like pricing, discount policies, and advertising practices. By contrast, social regulations refer to corporate responsibilities as in the field of consumer health and safety.

As mentioned before, this dissertation uses a multi-target research approach and connects VCM with the marketing of innovation. Exploring the meaning of VCM in industrial value chains and understanding the way of practicing and implementing VCM forms one of three major goals of this thesis. This involves two main research questions:

Q1: *In which industries or final applications is VCM a relevant and widely used marketing strategy*?

Q2: *How are the value chain and the VCM process designed in real-world examples*?

After developing a first understanding of the VCM phenomenon, the purpose is to understand the design and implementation process of VCM by studying real-world examples. The aim is to develop an understanding of critical constructs that influence the performance of VCM and their relationships. Based on these insights, research hypotheses focusing on the critical factors for the supplier's marketing success are derived. Thus, the second goal is to investigate the different VCM approaches and to analyze their effectiveness to increase the success rate of supplier innovations. Two other main research questions emerge which then form the second issue addressed in this study:

Q3: Which strategic approaches to VCM are pursued? What characterizes them?
Q4: Which factors have an impact on the effectiveness of the identified approaches?

The final goal in this dissertation is to compare the performance of VCM strategies and to study systematically the impact of the identified factors for the supplier's marketing success. This effect analysis is essential to determine which factors are sensitive, i.e. produce significant differences in the marketing performance. Considering the interaction effects, the analysis helps to test the robustness of VCM strategies and supports suppliers' choice of marketing strategy. It involves three further research questions forming the third main matter of research of this document:

Q5: How does the marketing performance differ across the VCM strategies?
Q6: How do the identified factors impact the supplier's marketing performance?
Q7: How do the identified factors interact?

4.2 Methodological Research Approach

The aim of this doctoral work is to discuss and assess the VCM concept. For this purpose, a multi-method research design is used to study the open research questions. In this dissertation, case study research is combined with computational modeling. As indicated by Johnson and Onwuegbuzie (2004), many research questions can be best answered by using a multi-method research design. The effective use of multiple methods helps to explain variance which would otherwise be neglected by mono-method studies (Jick 1979). Moreover, multi-method research can improve the robustness and generalizability of findings as it guarantees that the variance observed originates from that of a trait and not from the research method (Creswell 1994; Brewer and Hunter 1989). It helps to improve the possibilities of arriving at conclusions and will thereby increase validity (Shah and Corley 2006; Scandura and Williams 2000).

In this thesis, a two-phase approach is selected. As stated by Creswell (1994), this two-phase approach is called a sequential study. It starts with case study research and continues with a computational methodology. This implicates that the results of the case study are used to design a subsequent agent-based model. Figure 4.2 visualizes the research approach used in this dissertation.

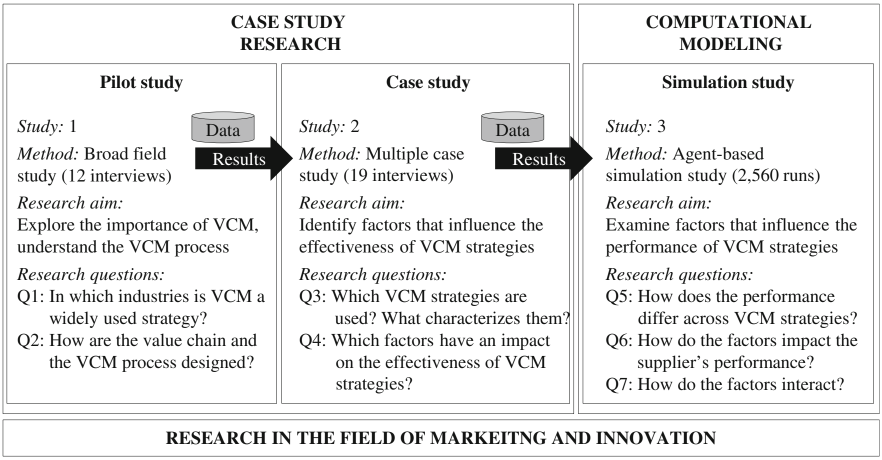

Fig. 4.2 Methodological research approach

To move into the field of VCM, a pilot study appears to be the most suitable approach (see e.g. Yin 2009; Dubé and Paré 2003) and will thus be described in Chap. 5. A pilot study is useful in determining the final research questions of the first main study, i.e. the case study. It helps to investigate the industries or final applications in which VCM is a highly relevant and widely used marketing strategy. As a result, the empirical field of the second (i.e. case study) and third study (i.e. agent-based simulation study) is defined. Furthermore, research propositions will be developed and tested in the second study.

Next, as it is appropriate for poorly understood or emerging phenomena like VCM, a case study will be conducted in Chap. 6 (Yin 2009; Boyer and Swink 2008; Gibbert et al. 2008; McDermott and O'Connor 2002; O'Connor 1998; Perry 1998). A case study, also labeled limited-scope study, is characterized by a narrow scope. Compared to a pilot study, this method allows for holistic and rigorous in-depth investigations (Yin 2009; Dubé and Paré 2003; Feagin et al. 1991; Benbasat et al. 1987; Bonoma 1985). Primarily used as a theory-building approach, case studies have been effectively used to understand why certain characteristics or effects occur, or do not occur (Meredith 1998). The special aim in this thesis is to portray the complexities and interactions of the VCM phenomenon by exploring its strategic approaches as well as the key constructs that seem to have an impact on the supplier's marketing success. In fact, case study research yields to *analytical generalizability* as it is generalizable to theoretical propositions and produces findings that may be transferable to other situations (Yin 2009; Meredith 1998). Since the purpose here is to develop a unique understanding of VCM projects, the case study cannot yield to *statistical generalizability*, i.e. generalizing findings and inferring conclusions about a population (Yin 2009; Meredith 1998; Numagami 1998). But this deficiency will be remedied by the third method.

Agent-based simulation (ABS), the third method in this thesis, produces simulated data and helps to obtain accurate statistical evidence on the distributions of variables within the population. This method is based primarily on artificial reconstructions of the object reality (Meredith et al. 1989). It is a computational abstract approach for modeling and simulating the behavior of interactions between autonomous entities, embedded in an environment. The aim here is to analyze and assess a multiplicity of VCM projects while looking at the reactions they provoke in a population. The agent-based model permits the evaluation of the effects of certain constructs (e.g. the newness of supplier innovation) on the marketing performance of VCM strategies (see Chap. 7). Moreover, it enables statistical analysis together with high reliability and facilitated replication.

Some details concerning the three specific research methods to discuss and assess the VCM phenomenon will be given in the following three subsections. In each subsection, a definition and a justification of the research method will be provided. In addition, the research focus and purpose will be described.

4.2.1 Pilot Study

A pilot study is defined as a pre-study of a larger study. In this thesis, it is conducted to prepare for the first main study, i.e. the case study, and identify the industries or final applications in which VCM is highly relevant. According to Yin (2009), a pilot study can help researchers to define the unit of analysis, to refine the data collection instruments, and to familiarize researchers with the phenomenon itself. It is an important research approach to test, revise, and sharpen research protocols and interviews (Goffin et al. 2012). In the words of De Vaus (1993, p. 54), "Do not take the risk. Pilot test first".

As stated in Sect. 1.2, the pilot study represents a rather broad approach to the VCM topic in order to confirm its relevance in industrial applications, to understand its processes and to identify further relevant issues. The aim is to learn from real-world examples by exposing specific VCM projects. Preinterviews with selected value-chain actors are conducted and a brief period of observation and document review follows. Finally, pilot interviews help to establish effective communication patterns (Denzin and Lincoln 1994).

4.2.2 Case Study

The case study is the first main study in this thesis and represents one example of inductive (qualitative) approaches to understand the VCM phenomenon (see Eisenhardt 1989). This method investigates a contemporary phenomenon within its real-life context, using different data collection instruments (e.g. interviews, archival data) to gather information from one or few people (Bonoma 1985; Kaplan

1985; Stone 1978). It is especially relevant if the boundaries between phenomenon and context are not clearly evident.

Case study research is appropriate if there is a complex observational task, if a holistic and superior understanding is required, and if a phenomenon cannot be investigated outside the context in which it occurs (see Yin 2009; Dubé and Paré 2003; Feagin et al. 1991; Benbasat et al. 1987; Bonoma 1985; Duncan 1979; McClintock et al. 1979). This method allows for a great deal of flexibility and individual variation (see Cavaye 1996). Benbasat et al. (1987, p. 370) identify three outstanding advantages of a case study. First, the investigator can study the phenomenon of interest in its natural setting, learn about the state of the art, and generate theories from practice. With respect to this thesis, the focus is to study the phenomenon of VCM in the chemical industry, learn from experiences of value-chain actors, especially the experience of marketing managers, and generate theories from real-world examples where VCM is used. Second, a case study allows the much more meaningful question of why, rather than just what and how, to be answered with a relatively full understanding of the nature and complexity of the relevant phenomenon. In this dissertation, it focuses on the identification of strategic approaches to VCM and the comparison of the effectiveness of these approaches to develop pertinent hypotheses for further inquiry (Yin 2009). Third, this research approach provides early, exploratory investigations where the variables are still unknown and the phenomenon not at all understood. Meredith (1998) states that case studies are primarily useful when developing new theory or testing specific aspects of an existing theory. This is essential in the VCM context. Studies cited in the marketing and innovation literature are neither referring to the VCM phenomenon nor the implementation of supplier innovations.

To summarize, case study research brings the researcher closer to the VCM phenomenon (see Bansal and Corley 2011; Roth 2007), allows an in-depth insight into contextual factors like the newness of supplier innovation (Meredith 1998; Bonoma 1985), and enables the researcher to discover patterns in the use of VCM (Eisenhardt 1989).

In this dissertation, a recently finalized marketing and innovation project is chosen and respondents are asked to discuss the concept of VCM and potential critical factors for the supplier's marketing success. As a result, research hypotheses on the concept of VCM are derived and summarized in an adapted framework (see Sect. 6.7). Once an empirically adapted framework has been established, it can guide the simulation study.

4.2.3 Simulation Study

The simulation study is the second main study in this thesis and represents a combination of an inductive (qualitative) and a deductive (quantitative) research approach. According to Axelrod (1997, p. 24), this methodology describes "a third way of doing science". It is like deduction by starting with explicit assumptions (rules). It then generates simulated data to be analyzed inductively using qualitative and quantitative tools. It is appropriate to make predictions as well as to develop, refine, test, and verify theory. In this dissertation, the aim is to refine, test, and verify theories that have been previously developed by multiple case studies.

Simulation is a research method which uses computer software to model the operational level of real-world processes, systems, or events (Law and Kelton 1991). This definition is consistent with other definitions in the literature that define simulation models as virtual experiments (Carley 2001) or as simplified pictures of the real world (Lave and March 1975). Like statistical models, a simulation model refers to an abstraction from and a simplification of the target system (Gilbert and Troitzsch 2005; Gilbert and Doran 1993), which is not directly observable or too complex to evaluate. In general, a model is smaller and less complex than its target. It is usually dynamic because real-world targets change over time and react to their environments (Gilbert and Troitzsch 2005).

A simulation allows the researcher to experiment with the model in place of the objective (Gilbert 2008). It is characterized by three main steps: developing a process theory, expressing the theory as a computer program, and simulating the theory by running the program (Taber and Timpone 1996, p. 3). The program enables the researcher to explore the dynamics of a target in a very precise way (Ostrom 1988). Simulations require some input, similar to independent variables, to produce via algorithms some output, similar to dependent variables (Gilbert and Troitzsch 2005).

An important type of simulation is agent-based modeling (ABM). It is an emerging and powerful tool for studying complex systems (e.g. Rand and Rust 2011; Schramm et al. 2010; Gilbert and Troitzsch 2005; LeBaron 2000; Epstein and Axtell 1996; Holland 1995) in a wide-range of fields of business-related research (e.g. North et al. 2010; Siebel and Kellam 2003; Walsh and Wellman 1999). Studies using ABM focus on simulating the dynamic behavior and interactions between many autonomous entities, called agents (Gilbert 2008; Gilbert and Troitzsch 2005). This implies that the unit of study is the individual or agent and not the population (Schramm et al. 2010; Garcia 2005).

Agents are heterogeneous in their properties and actions, adaptive and sensitive to history in their decision-making and interact with each other or their environment (see Rand 2006; Garcia 2005). As discussed by Jennings et al. (1998), there is little consensus in the literature regarding the definitions of agents. But researchers do agree on some features agents have: (1) ontological correspondence, (2) autonomy, (3) heterogeneity, (4) bounded rationality, (5) social ability, and (6) situatedness.

- *Ontological correspondence* refers to the correspondence between agents and actors in the target social system (Gilbert 2008). It facilitates the programming of agent-based models and the interpretations of simulation results.
- *Autonomy* declares that agents act independently. They are not controlled by a higher or global program (see Smith and Conrey 2007; Gilbert and Troitzsch 2005; Macy and Willer 2002).

- *Heterogeneity* reveals that agents within a model need not be equal. They can have different rules of actions (Gilbert 2008).
- *Bounded rationality* refers to the "practical reasoning" of agents (Smith and Conrey 2007; Macy and Willer 2002). The authors state that the agents act on pragmatic or heuristic reasoning assuming to prevail in humans. Thus, agents are characterized by attitudes, beliefs, desires, intentions, and goals.
- *Social ability* refers to the interaction of agents. They can pass information to each other by using a shared language (Gilbert 2008; Smith and Conrey 2007; Gilbert and Troitzsch 2005; Macy and Willer 2002).
- *Situatedness* describes that agents are embedded in a larger environment (see Gilbert and Troitzsch 2005). This environment represents a virtual world and refers to the target environment real actors interact with (Kahl 2012).

The benefits of ABM over other simulation methods are numerous. First, the unit of study is the individual or agent. Each agent has unique characteristics and decision rules it follows. It allows for a more realistic representation of the relevant phenomenon (Garcia 2005). With respect to this thesis, numerous agents with different knowledge bases can be created. Second, the behavior of a single agent (micro-level) represents the basis for the emergence of a collective's behavior as a whole (macro-level) (Macy and Willer 2002). Therefore, agent-based models can be used to illustrate systematically how simple rules of micro-level interaction can lead to global patterns or macro-level phenomena (see Janssen and Ostrom 2006). This benefit is based on the bottom-up approach by which an ABM is constructed. The programmer of an agent-based model only models the behavior and objectives of an individual because he or she cannot understand the whole phenomenon of interest. These individuals then interact with each other in a repetitive process. The repeated interactions, in turn, lead to global or macro trends and behaviors (Garcia 2005). In the model of VCM, the supplier interacts with applicators and/or manufacturers to implement his present innovation. The decision to accept and implement or reject an innovation depends on a supplier's ability to correspond to applicator's needs and requirements. Third, ABM is one among very few methods that enables adaptation or learning process on a microscopic level. In the context of VCM, suppliers get the ability to adapt their parameters of action over time. Finally, using ABM does not require an understanding of differential equations, integrals, or even statistics. It is easier to develop and use than other analytical models (Schramm et al. 2010). This advantage also facilitates the development of the VCM model.

In this thesis, ABM is used in the context of marketing and innovation. The basic concept here is to model the acceptance and implementation of supplier innovations by first describing simple rules of behavior for the different types of agents (suppliers, manufacturers, and end applicators) and then aggregating these rules. In particular, the case study results are used to set the agents' rules of behavior. The aim is to study and assess a multiplicity of VCM settings while looking at the reactions they provoke in a population. It helps to confirm the case study results and assist in identifying causal relationships that have previously gone unexplained

(Garcia 2005). Finally, the model is intended as a tool for suppliers to evaluate different VCM strategies.

4.3 Empirical Field

The chemical industry is the application field for this thesis. As uncovered from secondary research, the phenomenon of VCM is often observed in the chemical industry. This is based on the fact that chemical materials have to undergo several stages of processing or assembling until they arrive to their final destination. Their demand is thus of derivative nature. This, in turn, causes big difficulties in marketing, i.e. a high resistance to supplier innovations. In fact, the value of innovative materials is not always evident for suppliers' immediate customers. It becomes more obvious when these materials get closer to their final application. As a result, suppliers' immediate customers prefer to wait until they receive strong signals from their customers indicating the need for an innovation. To break through immediate customers' resistance of innovation, chemical suppliers rely more and more on VCM. That is their way to solve their marketing problems.

In the following section, characteristics of the chemical industry as well as market facts and figures are presented. Thereafter, particularities of specialty chemicals such as coatings and sealants, which are relevant for the considered case, are described.

4.3.1 Chemical Industry and Market

The chemical industry is one of the global "keystone" or enabling industries. This industry is critical about the global competiveness of other industries (Runge 2006). As presented by Rammer (2003), the German chemical industry is described as an "innovation engine". It is an important supplier of innovation. In particular, this industry plays a decisive role in adding new or enhanced functionalities. In the field of product surfaces, for instance, microstructures are imposed onto the surfaces. These may add self-cleaning properties exploiting the "Lotus Effect" or increase light reflection through "microreplication" (Runge 2006). The products of the chemical industry are typically in demand as they have specific characteristics, which in turn make them suitable for numerous applications. As a result, chemicals are sold for the properties they produce. Special properties are e.g. protection of material from corrosion, degradation or destruction of material, as well as replacement of other material to increase performance (Runge 2006).

In fact, the chemical industry is a sub-industry of the process industry. Products in process industries can be intermediates or finished products. In the chemical industry, almost 80 % of sales correspond to intermediates for other industries (Runge 2006). The structure of the chemical industry is characterized by different

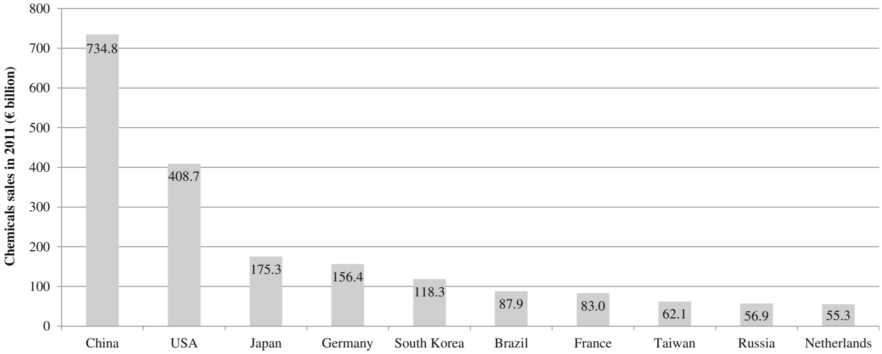

Fig. 4.3 Chemicals sales in 2011 (Cefic 2012b)

product classes starting with oil and gas and continuing with further refinements in the following steps with petrochemicals, basic chemicals, polymers, specialties, and active ingredients (Kannegiesser 2008).

The chemical industry is vital to the economy. In 2011, world chemical sales were valued at € 2,744 billion (Cefic 2012a). The European Union (EU) accounts for 20 % of this total. This industry is the third strongest branch of industry behind both mechanical and automotive engineering. China is by far the biggest chemicals producer (€ 734.8 billion). A comparison of the different countries is given in Fig. 4.3. The EU chemicals industry supplies virtually all sectors of the economy. The leading subsectors are petrochemicals and polymers, basic inorganic, consumer chemicals, and specialties.

4.3.2 Specifics of Specialty Chemicals

A key product classification scheme in the chemical industry is the distinction of commodities, fine chemicals, and specialty chemicals. An overview of the product classification scheme is provided in Table 4.1.

The term 'specialty chemicals' is frequently used as the antithesis to commodities. Examples of commodities are base chemicals that include petrochemicals, their derivatives, and basic inorganics. Commodities are produced in dedicated plants, sold in large volumes, and used for a large variety of applications (Pollak 2011). They offer a low value added and are more dependent on business cycles. Fine chemicals are complex, single, pure chemical substances produced in limited quantities in multi-purpose plants (Pollak 2011). They are sold on the basis of "what they are".

By contrast, specialty chemicals are characterized by low volumes in production but high margins in profit. In the literature, they are also called "effect chemicals" or "performance chemicals". This means that small amounts of substance can cause a big effect (Jakobi 2001) and that these chemicals improve the performance of

Table 4.1 Product classification scheme (Based on Pollak 2011)

Commodities	Fine chemicals	Specialty chemicals
Single pure chemical substances	Single pure chemical substances	Mixtures
Produced in dedicated plants	Produced in multi-purpose plants	Formulated
High volume	Lower volume	Low volume
Low price	Higher price	High price
Low value added	Higher value added	High value added
Low degree of differentiation	Low degree of differentiation	High degree of differentiation
Many applications	Few applications	Undifferentiated
Sold on specifications	Sold on specifications "what they are"	Sold on performance/functionality "what they can do"

either a manufacturing process or a final product (Runge 2006). Examples include adhesives, coatings, pigments, sealants, or high performance polymers. Specialty chemicals are most often classified according to the final application (Abratt and van Altena Lombard 1993). They are formulations of chemicals that include one or more fine chemicals or active ingredients (Pollak 2011). As stated by Runge (2006), working in specialty chemicals requires more knowledge about product offerings and specifications as well as customer needs.

4.3.3 Coatings and Sealants

As mentioned, coatings and sealants are examples of specialty chemicals and are the focused of this thesis. A coating covers a surface in order to improve its properties such as appearance/aesthetic appeal, adhesion, wetability, corrosion resistance, wear resistance, and scratch resistance. Coatings refer to diverse materials such as metal, plastics, paper, wood, leather, glass, clay, cement and mortar, but also to things like metal furniture, interior electric appliances, toys, bicycles, and roofing tiles (Runge 2006). A coating material can be a product in liquid, paste, or powder form. If applied to a substrate, it forms a film which has protective (inhibiting damages), decorative (colors, feelings and "touches"), and/or other specific properties (see Runge 2006; Bieleman 2000). The four main components of a coating material are binders or resins, pigments and extenders, solvents, and additives. As stated by Bieleman (2000, p. 1), the binder defines most of the key properties of the paint film like adhesion, resistance, as well as optical and mechanical properties. In turn, the pigments and extenders have an impact on the color and other properties like opacity and corrosion resistance. Solvents are important to enable the processing of the solid components. Although additives are added in small quantities, they have a major influence on different paint properties.

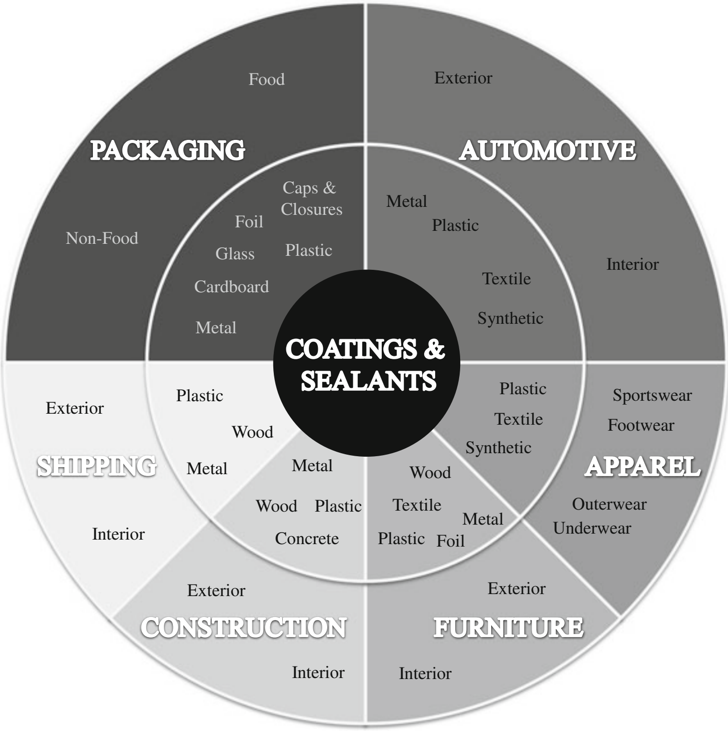

Fig. 4.4 Applications of coatings and sealants

A sealant is defined as a substance that is capable of attaching to two or more surfaces, and thus filling the space or gaps between them to provide a barrier or protective coating (Petrie 2000). The main property of a sealant is to prevent air, water, and other materials from entering or exiting a structure while permitting a certain amount of movement of sealed parts (Mittal and Pizzi 2008).

Coatings and sealants are used in a host of applications (see Fig. 4.4). One of these applications is the packaging industry divided into the food and the non-food segment. Examples of materials or products that are coated or sealed are foils, glasses, plastics, textiles, and synthetics. Moreover, coatings and sealants play a critical role in the automotive industry as they add or enhance functions of materials such as metals, plastics, textiles, and synthetics in the automotive interior or exterior. As depicted in Fig. 4.4, other applications of coating and sealant materials are the apparel industry with sportswear, footwear, outerwear, and underwear; the furniture industry; the construction industry; and the shipping industry with interior and exterior applications.

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Part III
Qualitative Studies

Chapter 5
Pilot Study

In a case study research, the purpose of a pilot study is to further refine the research with respect to content and procedure, but not to pretest as it is with survey research (Ellram 1996). While the pilot study could deliver interesting inputs for the overall research project, it also helps the researcher to improve his research plan before spending more time in the research field. In this thesis, the pilot study helps to investigate the industries or final applications in which VCM is a highly relevant and widely used marketing strategy. Therefore, the empirical field of the second study (i.e. case study) and the third study (i.e. agent-based simulation study) is defined.

In the following chapter, the pilot study is introduced by first describing the data collection process. Thereafter, the data analysis and the presentation of pilot study results are explained in detail. Finally, this chapter concludes with a short discussion of preliminary results and derives the research propositions that will be tested in the case study.

5.1 Data Collection

In the first step, an intensive desk research was done to study the coating sector and industry specific characteristics and identify experts. In the second step, potential interview partners for the research project were recruited by means of an e-mail describing the project (see Appendix A1). After approving their participation, an appointment with the respondent was arranged on the European Coatings Show (ECS) 2011 in Nuremberg. The ECS plus Adhesives, Sealants, Construction Chemicals is a leading exhibition for the international coating industry which takes place every 2 years.

Within the 3 days at the fair, 12 interviews with industry experts holding different positions (e.g. marketing manager, technology manager) in different firms were conducted (see Appendix A2). The designated experts are well-informed

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on the coating industry and its applications (e.g. automotive, packaging), know the value chains and their specific characteristics (e.g. number of stages, value-chain actors), have an idea about the relevance of VCM in coating applications, and can refer to specific examples of VCM.

In most cases, the interviewees were representatives of coating material suppliers. Interviews were based on a semi-structured protocol comprised of a set of open-ended questions (see Appendix A3). Each interview lasted from a minimum of 40 min to a maximum of 150 min, depending on the level of information each interviewee shared. Most interviews were taped. Moreover, secondary data including presentations, product information sheets, and press information were examined and analyzed to summarize the interviews and draw first conclusions.

5.2 Analysis and Results

After the ECS, the collected data were analyzed. First, the tape-recorded interviews were transcribed and the names of the involved firms were disguised. Second, the information were structured and summarized to three categories: (1) coating and its final applications, (2) value-chain characteristics, and (3) Value Chain Marketing. Third, the research questions presented in Sect. 4.1 were answered: In which industries or final applications is VCM a relevant and widely used marketing strategy? How are the value chain and the VCM process designed? The interviews were classified according to the final application.

As presented in Sect. 4.3.3, coatings are used in a host of applications. First, the four main applications where VCM is highly relevant are presented in more detail: automotive (OEM finishing), packaging, textile, and marine coating. Each application is describes with respect to the value the coating offers in this field, as well as the value chain and its specific characteristics (number of stage, value-chain actors, power distribution). Thereafter, a short overview of the applications where VCM is a rarely used strategy is given.

5.2.1 Automotive (OEM Finishing) Coating

One of the final applications of coating materials is the automotive industry. In this industry, a coating is adapted to two categories. The first category, labeled OEM finishing, attaches great importance to coating. “It improves the protection and appearance of vehicle bodies”.[1] Hence, the supplier of coating materials plays a critical role in the value chain. Due to the importance of coating materials, VCM is

[1] Interview with material supplier (position: Director Product Management Additives), 03/29/2011.

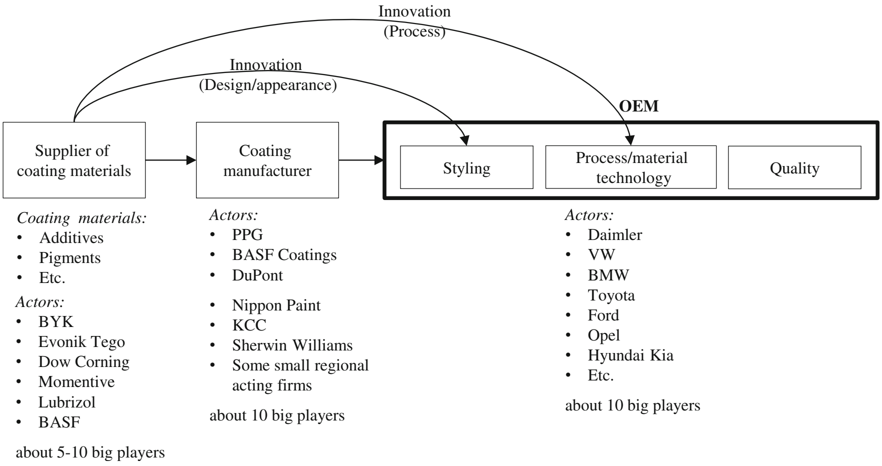

Fig. 5.1 Value chain OEM finishing

a relevant and widespread marketing strategy. The value chain is characterized by high competitive pressure. As noted by one interview partner, "the stage of the OEMs is subdivided into a styling, a process/material technology, and a quality function".[2] The styling team asks for paint innovations which mainly focus on visual effects. Technological innovations are presented to the process/material technology team because they look for paint protection, e.g. improved scratch resistance. The quality team, in turn, controls if the coating system is applied correctly. The number of big players is more or less equal on the different stages of the value chain. The stage of the OEMs is the center of power and the decision-making unit and is thus highlighted in Fig. 5.1. The second category, labeled automotive refinishing, represents an application where VCM is less important. This category is described in the second step (see further coating applications).

5.2.2 *Packaging Coating*

Coating materials are sold into the packaging industry in large volumes. They create an added value by protecting the packaged content and/or improving its visual attractiveness. This application is characterized by a very complex and competitive structure, with many stages between the material supplier and the brand owner or end applicator. Brand owners are the center of power (see Fig. 5.2). Due to the clear power structure, VCM is a frequently used marketing strategy to increase the success of supplier innovations.

[2] Interview with research firm (position: General Manager), 03/30/2011.

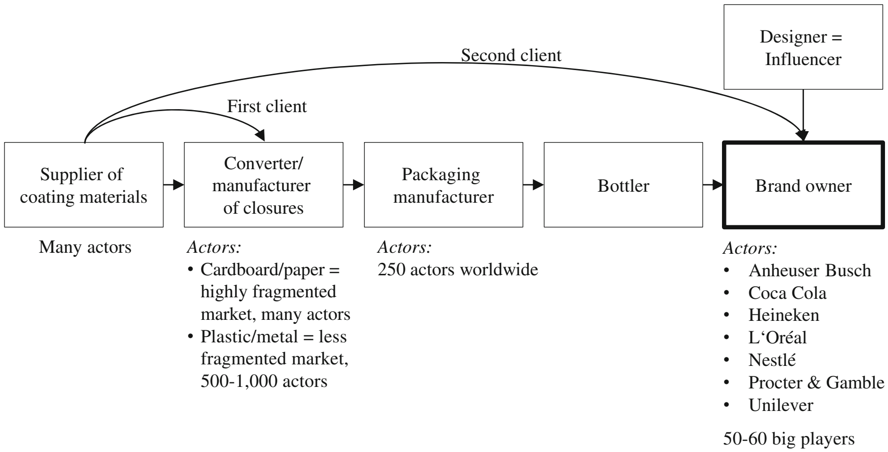

Fig. 5.2 Value chain packaging coating

In particular, "industrial designers play a critical role as influencers in this application value chain".[3] As stated in Sect. 2.3.1, they advise brand owners like Anheuser Busch, Coca Cola, and Heineken on purchasing decisions on packaging components. Moreover, they are also a critical source of innovative ideas or products.

5.2.3 Textile Coating

Coated textiles are applied to the automotive interior such as automotive seating. In this application, "coating (e.g. artificial or synthetic leather) is a critical component because it ensures durability, attractive haptic, and high comfort".[4] Coating material suppliers are perceived as an important source of innovations. Due to the clear power structure, VCM is a widely used marketing strategy (see Fig. 5.3). OEMs are the most powerful players in the value chain and are able to create a strong demand pull. The apparel and sports industry is another customer of coated textiles. The structure of this value chain equals that of the automotive interior. The end applicators are called brand owners (e.g. Adidas, Nike, and Puma). In this industry, "VCM is considered as a promising marketing strategy to increase the success of supplier innovations".[5]

[3] Interview with material supplier (position: Chief Technology Manager), 03/30/2011.

[4] Interview with material supplier (position: Senior Manager Textile Coating), 03/30/2011.

[5] Interview with material supplier (position: Senior Manager Textile Coating), 03/30/2011.

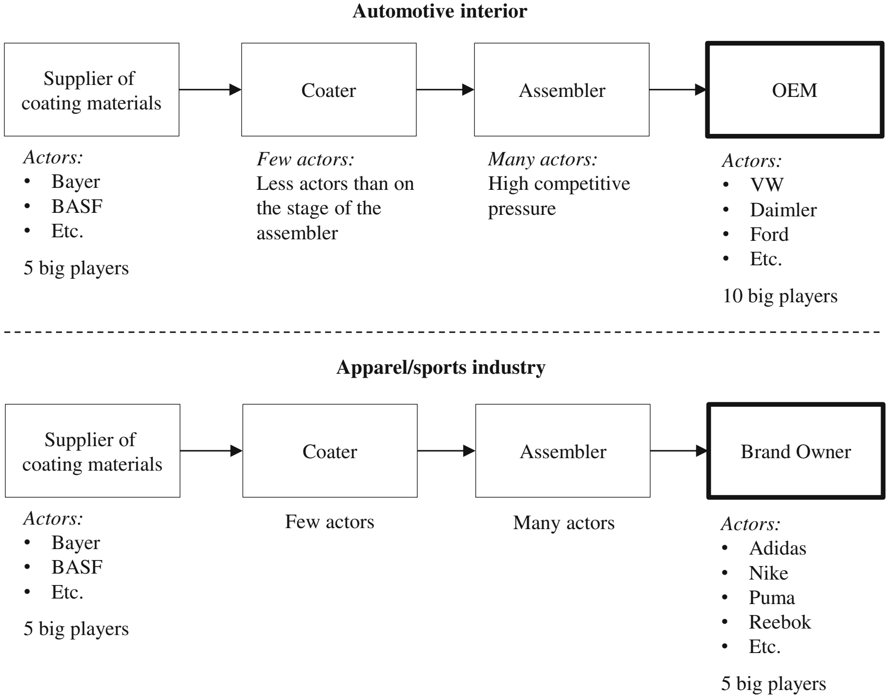

Fig. 5.3 Value chain textile coating

5.2.4 Marine Coating

With a desire for performance and functionality, coating material suppliers also deliver marine coating technologies that protect shipping fleets during their operating lifetime on the sea. In this application, the quality of coating determines the amount of maintenance. "It makes a world of difference if a ship is maintained every 5 or every 10 years".[6] This implicates that the cost decreases with a smaller maintenance effort. The value for money is crucial for the shipping companies or owners. As highlighted in Fig. 5.4, they are the center of power and the decision-making unit in this value chain. VCM is rarely used in this value chain although it is highly relevant. This is based on the fact that suppliers of coating materials are afraid of risking their business relationships with coating manufacturers like Akzo and PPG. By following the rules set by the International Maritime Organization (IMO), coating manufacturers have to invest a great deal of money to implement a new coating system. They are often characterized by a dismissive attitude toward innovative coating materials. The Technischer Überwachungsverein (TÜV), in turn, controls if the coating system is applied correctly.

[6] Interview with material supplier (position: Global Strategic Marketing Manager), 03/31/2011.

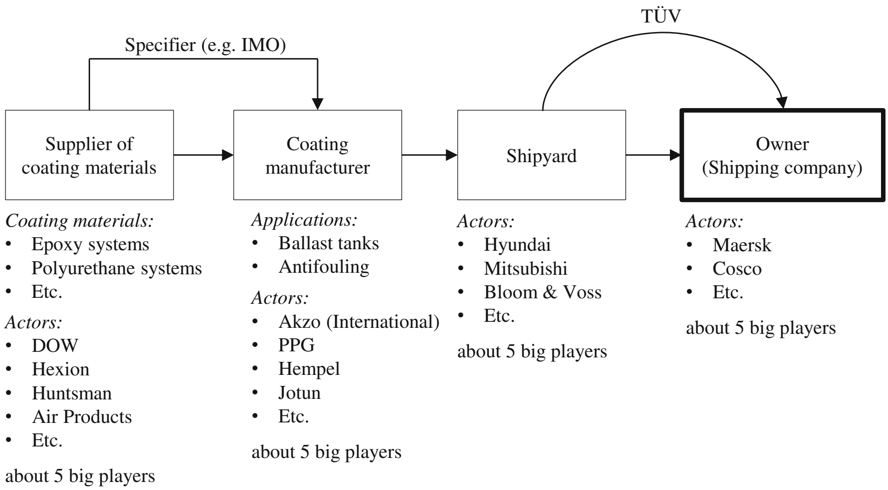

Fig. 5.4 Value chain marine coating

5.2.5 Further Coating Applications

As mentioned at the beginning of Sect. 5.2, the second category in automotive coating is known as *automotive refinishing*. This category deals with automotive repair coatings. Here, the stage of the paint shops is highly fragmented and the distributor, i.e. the stage after the coating manufacturer, represents the center of power. "While coating is an important feature of automotive, paint shops do not have the power to create a strong demand pull".[7] Therefore, VCM is less effective. Suppliers usually approach the value chain by dealing with coating manufacturers (i.e. their immediate customers) and essentially pushing their innovations into the value chain. A visual representation can be found in Appendix A4.

In the *construction industry*, the stage of the applicator (i.e. users) is highly fragmented (see Appendix A4). Suppliers' immediate customers (i.e. paint manufacturers) represent the center of power, but "they try to hinder supplier innovations".[8] In this application value chain, push marketing is more important than pull marketing or VCM. The same situation can be observed in the *furniture industry*, with one exception: IKEA.[9] In contrast to the numerous small furniture manufacturers, "IKEA is the most powerful player and stipulates the rules of the value chain in this industry".[10]

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[7] Interview with material supplier (position: Director Product Management Additives), 03/29/2011.

[8] Interview with material supplier (position: Head of Global Competence Center Paint), 03/30/2011.

[9] Interview with material supplier (position: Manager Global Strategic Marketing), 03/30/2011.

[10] Interview with material supplier (position: Technical Manager BU Wood & Furniture), 03/30/2011.

To summarize, the last paragraphs discuss the relevance of VCM in different coating applications and provide information about the value-chain structure. The crucial point is that VCM is highly relevant and frequently used if the coating is of great importance for the final product (e.g. automotive, packaging) and if there is a clear power structure, i.e. the applicator represents the center of power. These conditions are particularly fulfilled in the OEM finishing as well as the textile and packaging coating. By pursuing VCM, suppliers enlarge their target group beyond their immediate customers and regularly interact with customers down the value chain. Some popular examples named by the respondents are Gore-Tex® in the textile industry, Teflon® Fabric Protector in the furniture industry, and Tetra Pak® in the packaging industry. A summary of the results and some additional information are presented in Table 5.1.

5.2.6 VCM Process

Regarding the VCM process, the interview partners state that the nature of this process depends on the timing of integrating the immediate customer, i.e. the manufacturer. They differentiate between the integration of the manufacturer at the very beginning of the process or at a later stage. Based on the explanations of the respondents, an early integration of the manufacturer implies that the manufacturer takes an active part in the process: The supplier and the manufacturer seem to cooperate. They jointly target the applicator to explain the innovative coating materials. If the manufacturer, in turn, is integrated at a later stage, he plays a passive role in the process. The supplier uses an autonomous approach. He directly addresses the applicator, who convinces the manufacturer of adopting the innovation without previously consulting him. Concerning the coating applications where VCM is a common marketing strategy, the process is described as follows:

- *Automotive (OEM finishing) coating:* Here, the supplier of coating materials usually integrates the coating manufacturer at a later stage of the VCM process. "It is a promising approach because OEMs are open to supplier innovations in order to gain a competitive advantage".[11] In fact, they signal readiness to support the implementation of all kinds of innovations and regularly interact with suppliers.
- *Textile coating:* In this coating application, the supplier also decides in favor of a late integration of the coater. He directly targets the stage of the applicators. "To correspond to consumer needs and requirements, OEMs or brand owners are usually interested in innovative coating solutions".[12] They support and engage in

[11] Interview with research firm (position: General Manager), 03/30/2011.

[12] Interview with material supplier (position: Senior Manager Textile Coating), 03/30/2011.

Table 5.1 Pilot study summary

	Automotive industry Automotive coating	**Automotive industry** Textile coating	**Apparel industry** Textile coating	**Packaging industry** Packaging coating	**Shipping industry** Marine coating	**Furniture industry** Wood coating	**Construction industry** Industrial coating	**Construction industry** Decorative coating
Coating and its application								
Value of coating for application	Very high value	High value	High value	High value	Very high value	High value	High value	Medium value
Main function of coating	Protection and appearance	Protection and appearance	Performance/ functionality	Protection and appearance	Protection	Protection and appearance	Protection	Appearance
Value-chain characteristics								
Stages and actors *(Center of power)*	OEM finishing: – Supplier – Coating manufacturer – *OEM* Automotive refinishing: – Supplier – Coating manufacturer – *Distributor* – Paint shop	– Supplier – Coater – Assembler – *OEM*	– Supplier – Coater – Assembler – *Brand owner*	– Supplier – Converter – Bottler – *Brand owner* – Retailer	– Supplier – Coating manufacturer – Shipyard – *Owner*	– Supplier – Paint manufacturer – Paint shop – Manufacturer of furniture	– Supplier – Coating manufacturer – Manufacturer of metal	– Supplier – *Paint manufacturer* – Retailer (DIY store) – Applicator (end customer)
Driver of innovation	Government regulations, OEM, supplier	Government regulations, OEM, supplier	Brand owner, supplier	Government regulations, brand owner, supplier	Government regulations, shipyard/ owner	Government regulations, manufacturer of furniture	Government regulations, coating manufacturer	Government regulations, paint manufacturer

Value Chain Marketing								
Relevance	Highly rele-vant in OEM finishing	Highly relevant	Relevant	Highly relevant	Highly relevant	Less relevant: market is too fragmented; but it will be more relevant in the next years	Less relevant; but it will be more relevant in the next years	Less relevant: decorative market is too frag-mented
Usage	Widespread strategy (OEMs are open to VCM)	Widespread strategy (OEMs are open to VCM)	Common strategy (Owners are open to VCM)	Widespread strategy (Owners are open to VCM)	Known but rarely used strategy	Rarely used strategy	Rarely used strategy	Rarely used strategy
Well-known example	Lotus Effect®	Teflon® Fabric Protector	Gore-Tex®	Tetra Pak®	–	–	–	Lotus Effect®
Regular interaction	Supplier + OEM regularly interact	Supplier + OEM regu-larly interact	Supplier + brand owner interact	Supplier + brand owner regularly interact	Supplier + owner interact	Supplier + fur-niture manufac-turer rarely interact	Supplier + metal manufacturer rarely interact	Supplier + end customer rarely interact

new supplier products and value the supplier as an important source of innovation.

- *Packaging coating:* A material supplier prefers the late integration of a converter. But sometimes the perceived distance between the supplier and the brand owner is too big. This is based on the fact that suppliers and brand owners are rooted in different disciplines (i.e. chemical vs. product-related or user field) and their daily routines are determined by too different business activities (see Sect. 3.3.2). In other words, both actors only share a small amount of knowledge and experience. As a result, "problems in communication occur and call for an early integration of the converter".[13] To reduce the perceived distance, the converter acts as a mediator between material supplier and brand owner.
- *Marine coating:* Here, material suppliers rarely pursue an autonomous approach. "The fear to place their business relationships with coating manufacturers at risk is simply too high".[14] Moreover, really new coating materials offer an enhanced product functionality (e.g. improved corrosion resistance), but also require a new technique to apply the coating system on the hull. This, in turn, implies that shipyards have to invest in new spraying equipment to apply the system correctly. To select the matching equipment, an early integration of the coating manufacturer is absolutely essential. They offer all technical information needed to ensure a correct application of the coating system.
- *Wood coating (furniture industry):* As stated before, VCM is a rarely used marketing strategy in this application. "If VCM is used, the paint manufacturer is integrated at the beginning of the process".[15] This is the only way to "gain access to the highly fragmented stage of furniture manufacturers".[16]

5.3 Discussion of Findings and Research Propositions

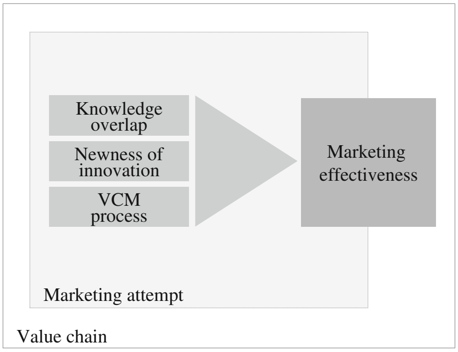
Through this pilot study, the author of this thesis has confirmed the relevance of VCM, studied the structure of different value chains and understood the general VCM process. The structure of the VCM process depends on the timing of integrating the manufacturer. A differentiation between an early and a late integration of the immediate customer can be made. During the pilot study, the interviews suggest that there is a preference for the integration at a later stage of the VCM process. It allows suppliers to leapfrog manufacturers and thus reduce their dependence on manufacturers. By integrating the manufacturer at a later stage, the main beneficiaries, i.e. the applicators, are directly addressed. But if the distance between

[13] Interview with material supplier (position: Chief Technology Manager), 03/30/2011.

[14] Interview with material supplier (position: Global Strategic Marketing Manager), 03/31/2011.

[15] Interview with material supplier (position: Technical Manager BU Dispersions), 03/30/2011.

[16] Interview with material supplier (position: Technical Manager BU Wood & Furniture), 03/30/2011.



Knowledge overlap:
- Small overlap
- Medium overlap
- High overlap

Newness of innovation:
- Process-driven innovation
- Functionality-driven innovation
- Really new product

Marketing effectiveness:
- Successful implementation (marketing success)

VCM process:
- Synergetic approach: Early integration of the manufacturer
- Autonomous approach: Late integration of the manufacturer

Fig. 5.5 Refined conceptual framework of VCM

a supplier and an applicator is too big and/or a supplier innovation requires portraying complex technical product features or consequences, an early integration of the manufacturer seems to be essential. In total, the design of the VCM process seems to be influenced by the amount of knowledge the involved value-chain actors share and the degree of newness that characterizes the focal supplier innovation.

Overall, the pilot study helps to define the unit of analysis. In this dissertation, it is the supplier's marketing attempt to implement his innovation via VCM. The results also contribute to refine the research with respect to content and procedure. Concerning the content, the constructs introduced in Sect. 4.1 are refined. Instead of considering the value-chain actors in general, it is more appropriate to focus on the knowledge the value-chain actors share, i.e. the overlap between their knowledge bases. Furthermore, special attention is given to the newness of innovation as a distinctive characteristic in suppliers' marketing attempts. Regarding the procedure, the research field is expanded and the coatings and sealants industry is considered. The refined conceptual framework is shown in Fig. 5.5.

Based on the pilot study, first ideas of the key variables impacting the effectiveness of a supplier's marketing attempt to implement innovations via VCM are developed. In the next paragraphs, two basic research propositions referring to VCM and its marketing effectiveness are compiled. These propositions are supported by illustrative quotations that are collected during the pilot interviews. A summary of the enabling factors, the basic propositions, and the illustrative quotations is given in Table 5.2.

As discussed in Sect. 3.2, four types of innovation which differ in their degree of newness based on the manufacturer's and the end applicator's perceptions of newness are classified: (1) incremental innovations, (2) functionality-driven innovations, (3) process-driven innovations, and (4) really new products. Based on the statements of the interview partners, the newness of supplier innovation seems to have an impact on the effectiveness of VCM. One of the respondents notes: "Different types of supplier innovations require different VCM processes".[17] The

[17] Interview with material supplier (position: Global Strategic Marketing Manager), 03/31/2011.

Table 5.2 Enabling factors for the design and effectiveness of VCM

Enabling factors	Basic propositions		Illustrative quotations
Newness of innovation	P1:	The design and marketing effectiveness of a VCM process depends on the newness of supplier innovation.	"Different types of supplier innovations require different VCM processes."
			"The timing of integrating the immediate customer (i.e. the manufacturer) greatly depends on the innovation itself."
Knowledge overlap	P2:	The design and marketing effectiveness of a VCM process depends on the overlap between the knowledge bases of the actors.	"If the communication partners do not speak the same language, there will be big problems in communication, which in turn reduce the probability to reach an agreement."
			"A common ground facilitates the communication and the decision-making process."

respondent further suggests that it makes a difference if a supplier innovation just offers a new product functionality or if it also requires changes the manufacturing process. Another interviewee reinforces this statement. He notes that "the timing of integrating the immediate customer (i.e. the manufacturer) greatly depends on the innovation itself".[18] This leads to the first proposition.

Proposition 1: The design and marketing effectiveness of a VCM process depends on the newness of supplier innovation.

Besides the newness of innovation, the knowledge bases of the actors are discussed as another important parameter when marketing supplier innovations via VCM. As stated in Sect. 3.3.3, a firm's knowledge base refers to the set of knowledge a firm has. The knowledge bases of the firms are located at different points in the value-chain space. To communicate effectively, the involved actors have to appeal to their common ground or shared knowledge bases in the form of language, shared meaning, or mutual recognition of knowledge domains (see Grant 1996; Isaacs and Clark 1987; Clark 1985; Clark and Murphy 1982; Clark and Marshall 1981). One respondent argues: "If the communication partners do not speak the same language, there will be big problems in communication, which in turn reduce the probability to reach an agreement".[19] Another respondent reinforces this statement: "A common ground facilitates the communication and the decision-making process".[20] This leads to the second proposition.

Proposition 2: The design and marketing effectiveness of a VCM process depends on the overlap between the knowledge bases of the actors.

[18] Interview with material supplier (position: Chief Technology Manager), 03/30/2011.

[19] Interview with material supplier (position: Senior Manager Textile Coating), 03/30/2011.

[20] Interview with material supplier (position: Director Product Management Additives), 03/29/2011.

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Chapter 6
Case Study

Based on the pilot study results, a case study is conducted with the purpose to deeply analyze the different strategic approaches to VCM and explore the variables that seem to affect the supplier's marketing performance. The unit of analysis is the supplier's marketing attempt to implement his present innovation via VCM. In each respondent firm, a recently finalized innovation or marketing project is selected and respondents are asked to discuss the VCM steps and the critical factors for the marketing success.

In this chapter, the case study is introduced by first describing the multi-case study design. Second, the case selection and data collection process are described in more detail. Third, a discussion about the rigor or quality of case study research follows. Next, the different cases are introduced before presenting the case study analysis and results. This section is divided into a within-case and a cross-case analysis. The aim here is to answer the third and fourth research question: (3) Which strategic approaches to VCM are pursued? What characterizes them? (4) Which factors influence the marketing effectiveness of the identified approaches? Finally, this chapter concludes with a discussion of intermediate results and derives the research hypotheses that will be tested in the simulation study.[1]

6.1 Multi-Case Study Design

The first central question that arises in the case study research is the question of the type of research design. Yin (2009) describes four different types of research design. The designs can be segregated by the number of cases, i.e. single vs. multiple cases, and by the number of units of analysis, i.e. single vs. multiple

[1] Parts of this chapter are published (see Toth and Lüthje 2012).

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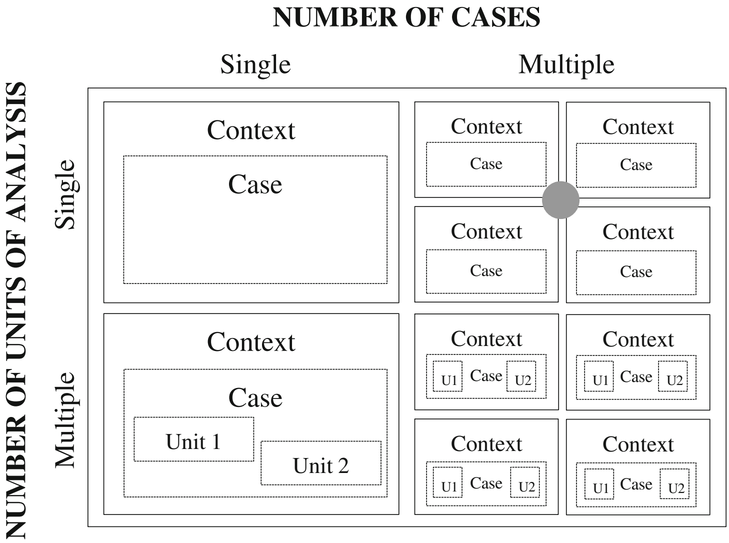

Fig. 6.1 Case study typology (Based on Yin 2009)

units of analysis. In this study, a multi-case design with a single unit of analysis is performed. The selection is highlighted in Fig. 6.1. The relevant unit of analysis is represented by the marketing attempt of a supplier to implement his present innovation. The supplier firm embodies the case.

The main reason for choosing a multi- over single-case study design is to present contrasting findings when promoting supplier innovations via VCM (Ellram 1996). In other words, it is not of interest to investigate a revelatory, critical, or extreme case (Yin 2009). A multi-case study design allows a cross-case analysis to identify, compare, and contrast patterns in the use of VCM (Yin 2009; Eisenhardt 1989; Benbasat et al. 1987). As discussed by Voss et al. (2002), multiple cases can increase external validity and help to protect against observer bias. Furthermore, it helps to create more robust and testable theory than single-case study research (Barratt et al. 2011; Yin 2009; Eisenhardt and Graebner 2007). In sum, five cases are provided to support or reject the initial set of propositions.

6.2 Case Selection

The second question that arises in the case study research is the question of how the cases are selected. Cases are usually chosen based on their substantive significance or theoretical relevance (see Ragin 1999). When conducting a single-case study, the case selection should be based on the fact that a case is revelatory (Cross et al. 1997), critical (Pinsonneault and Kramer 1993), or extreme/unique (El Sawy and Bowles 1997). As stated by Yin (2009), the selection of cases in a multi-case study design should either follow a literal or theoretical replication logic. Conditions of the case that lead to predicting the same results describe a literal replication logic, while conditions of the case that lead to predicting contrasting results refer to a theoretical replication logic (Dubé and Paré 2003).

In this thesis, a theoretical replication logic is adopted to identify different patterns in the use of VCM (Miles and Huberman 1994; McCutcheon and Meredith 1993; Eisenhardt 1989). In order to identify firms of potential interest, i.e. suppliers, manufacturers, and applicators, the contacts made at the ECS are used. This implies that firms that either pursue VCM or are confronted with VCM activities are contacted. These firms operate in different applications, have a different set of knowledge and experience in or with VCM, and offer or request innovations with different features. Approximately 25 firms are contacted by telephone or e-mail. Some firms are not interested or able to participate in the research project. In consequence, those firms are immediately disregarded. The selection process yields in a final list of 14 firms that express their willingness to participate in the research project. The net result is that five case studies are performed. This corresponds to the recommendation of Eisenhardt (1989). She specifically suggests that in the range of four to ten cases "usually works well" (p. 545).

In each of the cases, the supplier introduces a chemical innovation which delivers protection and an attractive appearance to materials such as cardboard, plastic, metal, or synthetic leather. The cases are selected in such a way as to maximize variations on dimensions that are of potential importance for VCM (see Fig. 6.2). Thus, the researcher of this study looks for cases that are expected to be different with respect to:

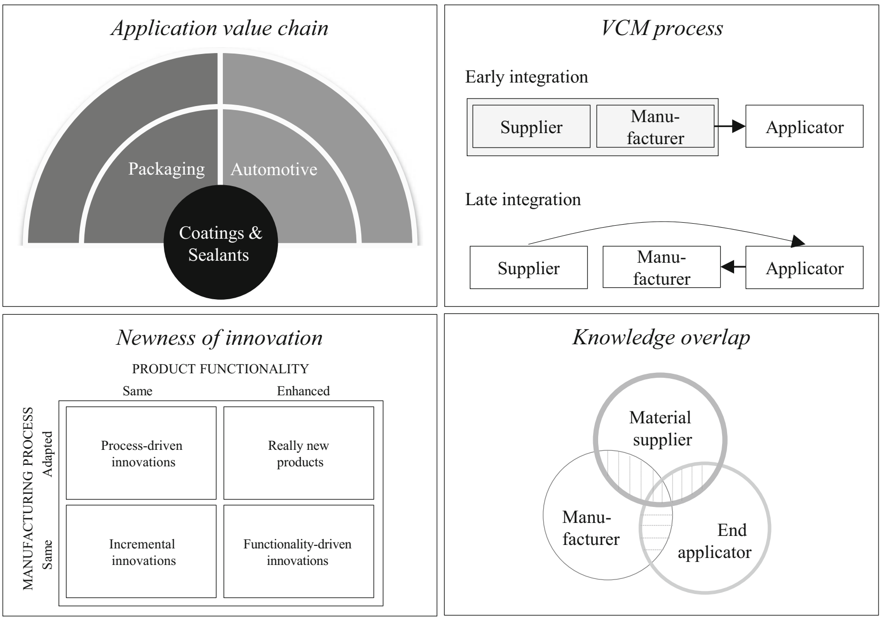

Fig. 6.2 Case selection process

- the value chain the relevant applicator is part of and where VCM is a common marketing strategy to promote and implement supplier innovations (i.e. automotive or packaging industry),
- the VCM process suppliers pursue to implement their present innovations (i.e. early vs. late integration of the manufacturer),
- the degree of newness that characterizes the supplier innovation (i.e. process-driven innovation, functionality-driven innovation, or really new product),
- the overlap that exists between the knowledge bases of the involved actors (i.e. small, medium, or high overlap), and
- the final result of a supplier's attempt to implement his present innovation (i.e. acceptance vs. rejection of a supplier innovation).

6.3 Data Collection

First, preparatory desk research, based on accessible documents and websites, was carried out for each case study. It followed a common structure for all five cases. Next, a field research plan was developed for interviews with key informants in the focal value chains. A clear description of data sources is given in the next paragraphs.

As mentioned before, an e-mail describing the research project was sent to potential respondents to solicit their participation. An example is included in Appendix B1. After approving their participation, a copy of the types of questions to be asked in the interview was mailed to the respondent prior to the interview. Hereby, the investigator ensures that respondents have some time to reflect on VCM.

The interviewees were suppliers and applicators as well as manufacturers if the manufacturer is integrated at the very beginning of the VCM process. They were significantly involved in the marketing project (i.e. the project where innovations of suppliers should be promoted and implemented via VCM) and hold different positions including senior managers, project managers, or marketing managers. At least one member of each value-chain stage involved in the project was interviewed (see Appendix B2). In four cases, multiple respondents from the same case study firm were interviewed to collect data, enhancing the validity of the responses: two respondents of one of the applicators in Case 1, two respondents of the applicator in Case 2, two respondents of the supplier in Case 3, and three respondents of the supplier in Case 4. Each interview included, inter alia, questions about the background of the marketing project, the steps taken to promote and implement the respective supplier innovation, and the problems experienced in implementing supplier innovations via VCM.

Interviews were based on a semi-structured protocol comprised of a set of open-ended questions. This implies that the interview tool was updated based on emerging data (Barratt et al. 2011). For instance, the question of marketing instruments or activities material suppliers utilize during the VCM process are divided into internal activities to organize for VCM (e.g. creating a task force) and external activities to practice VCM (e.g. flyer for end applicators, value pricing). To ensure reliability of data collection, a structured protocol was used (see Appendix B3). As noted by Dubé and Paré (2003), a case study protocol comprises more than the interview instruments. The authors suggest that it should also provide information about procedures and general rules that should be followed in using the instruments. In this study, the protocol was reviewed by respondents and was refined over time. Moreover, a case study database was created including the following elements: interview transcripts, researcher's field notes, documents like product information sheets gathered during data collection, summarized and analyzed data sets, memos, as well as data displays.

Overall, 19 interviews were conducted over a period of 1 year. 12 of the interviews were face-to-face interviews at the respondents' place of work. The rest of the interviews were conducted by telephone. Each interview lasted from a minimum of 60 min to a maximum of 120 min (on average 80 min), depending on the level of information each respondent shared. Unclear answers were clarified via telephone or e-mail. Most interviews were taped and detailed transcripts were produced. When interviews were not taped, notes were taken, which were transcribed and elaborated on immediately following the interview. The interview transcripts were returned to the respondents to insure accuracy in data collection.

In addition to interviews, secondary data were examined and reviewed including project documentation (available for two marketing projects), firm presentations, product information sheets, press information, (environmental) guidelines, and articles. These data sources were essential to collect more information about the involved value-chain actors, to gain a complete understanding of the supplier innovation and its applications, features, and benefits, as well as to have an overview of the VCM activities material suppliers use to promote their innovation. By combining or triangulating multiple data sources, the case study results or conclusions are likely to be much more convincing and accurate (see Yin 2009; Mingers 2001; Sawyer 2001; Patton 1999; Gallivan 1997; Jick 1979). In other words, triangulation increases reliability of data and provides stronger validation of expressed constructs and propositions (see Voss et al. 2002; Boyer and McDermott 1999; Hyer et al. 1999; Leonard-Barton 1990).

6.4 Assessing Quality of Research

To assess the quality of the case study research, a list of attributes is used. This list is presented by Dubé and Paré in (2003) and is based on the work of Benbasat et al. (1987), Eisenhardt (1989), Lee (1989), and Yin (2009). These researchers compile a set of guidelines and attributes that help to improve the quality of case study research.

The list presented in Table 6.1 covers three main topics: (1) research design, (2) data collection, and (3) data analysis. The first topic includes the attributes that

Table 6.1 Case study quality (Based on Dubé and Paré 2003)

	Chapter	Brief summary
Topic 1: Research Design		
Clear research questions	4.1 (39–41)	Which VCM strategies are pursued? What characterizes them?
	4.2 (42–43)	Which factors influence the effectiveness of these strategies?
Clean theoretical slate	5.2 (52–58)	Pilot study results: a priori specification of constructs to shape the initial design of the case study research
	5.3 (58–60)	– VCM process (early vs. late integration of the manufacturer) – Newness of supplier innovation (process-driven innovation, functionality-driven innovation, really new product) – Knowledge overlap (small, medium, high)
Unit of analysis	6.1 (61–62)	A supplier's marketing attempt to promote and implement an innovation via VCM
Multi-case study design	6.1 (61–62)	Present five cases varying in terms of the application value chain, the VCM process, the newness of supplier innovation, the knowledge overlap, and the final marketing result
Theoretical replication logic	6.2 (62–63)	Predict contrasting findings to identify, compare, and contrast patterns in the use of VCM
Pilot study	5.2 (52–58) 5.3 (58–60)	Pilot study: investigate the industries in which VCM is relevant, understand the value chain and the general VCM process
Topic 2: Data Collection		
Clarification of data collection process	6.3 (63–65)	Interviews with supplier, manufacturer, and applicator firms (if possible multiple respondents from the same case study firm)
		Additional data sources: project documentation, product information sheet, press information, etc.
Data triangulation	6.3 (63–65)	Combine primary data (interviews) and secondary data (e.g. project documentation) to validate the case study results
Case study protocol	6.3 (63–65)	Provide a protocol including the interview instrument, and procedures and rules that should be followed in using the instrument
Case study database	6.3 (63–65)	Provide a database including interview transcripts, researcher's field notes, data displays, etc.
Topic 3: Data Analysis		
Clarification of data analysis process	6.6 (71–72)	Describe the categorization and coding process
		Describe the within- and cross-case analysis
Coding and reliability check	6.6 (71–72)	Combine open and axial coding
Data displays	6.5 (67–71)	Summarize the case study descriptions
	6.6.1 (72–83)	Visualize the initialization of each case
	6.6.1 (72–83)	Summarize the within-case analysis
	6.6.2 (83–89)	Summarize the case study patterns

(continued)

Table 6.1 (continued)

	Chapter	Brief summary
Logical chain of evidence	6.6.1 (72–83)	Describe each case based on the defined categories (initialization, product development, product launch, product characteristics, VCM, implementation, and problems)
Quotes (evidence)	6.5 (67–71)	Use quotes to "bring the voice of participants in the study" (Creswell 1998, p. 170)
	6.6.1 (72–83)	
Searching for cross-case patterns	6.6.2 (83–89)	Identify patterns in the use of VCM across the five cases
		Compare and contrast these patterns
Summarizing key findings	6.7 (89–99)	Discuss and interpret the central findings
		Derive research hypotheses

deal with the design of the case study, like the nature of research questions and the unit of analysis. The second topic documents the quality of the data collection process. This topic considers the data collection methods and tactics used to improve the validity and reliability. The final topic, data analysis, deals with the description of the process and use of preliminary techniques such as coding of data. Table 6.1 lists all attributes that characterize the present case study research. In addition, the list shows the chapter where to find the respective attribute in this dissertation.

The consideration of the attributes listed in Table 6.1 helps to improve (1) external validity, (2) reliability, (3) construct validity, and (4) internal validity. The first measure, *external validity or generalizability*, has to be divided into analytical and statistical generalization (see Sect. 4.2). Case studies allow for analytical generalization that refers to generalization from empirical observations to theory, rather than a population (see Yin 2009). To provide a good basis for analytical generalization in this thesis, a cross-case analysis is presented (Eisenhardt 1989). The second measure, *reliability*, refers to the repeatability of the experiment and thus the question if replication is possible and leads to the same results (see Yin 2009; Denzin and Lincoln 1994). To enhance reliability, a case study protocol is used and a case study database including a documentation of the procedures followed is created (see Yin 2009; Leonard-Barton 1990). The third measure, *construct validity*, refers to establishing proper operational measures of the concept being studied (see Gibbert et al. 2008; Ellram 1996). It has to be considered during the data collection process. In this thesis, there are different elements to address construct validity: (1) using data triangulation (i.e. combine primary and secondary data), (2) establishing a chain of evidence (i.e. describe each case based on defined categories), and (3) having key informant reviews. The fourth measure, labeled *internal validity*, alludes to properly interpret the collected data, address alternative descriptions and use convergent data (see Ellram 1996). This measure is also called 'logical validity' (Yin 2009; Cook and Campbell 1979) and refers to the causal relationships between variables and results (Gibbert et al. 2008). The internal validity is enhanced by a clear research framework, pattern matching, and theory triangulation.

6.5 Case Descriptions

In the following section, the five cases are presented in a descriptive format. In each of the cases, the supplier introduces a chemical innovation which delivers protection and an attractive appearance to materials such as cardboard, plastic, metal, and synthetic leather. Table 6.2 provides an overview of the cases that are included in the study. For reasons of confidentiality, the names of the involved firms are disguised.

Case 1: Functional Barrier Against Mineral Oil Residues in Cardboard Packaging

The material supplier in this case is a multinational firm. He offers materials for barrier coating for almost all types of packaging and conventional production processes. In 2010, scientists of the Food Safety Authority (FSA) of Zurich measured alarming levels of mineral oil residues from cardboard packaging in food. Cardboard packaging is usually made of recycled paper and still contains mineral oil residues from printing inks. These residues evaporates at room temperature and are deposited on dried foods packaged in the box, including breakfast cereals, pasta, rice, noodles, and semolina.

To solve the big migration problem, three different solutions are considered. First, the packaging industry has to limit on only using fresh fibers. This turns out to be an unattractive solution. Fresh fibers cannot work on the same machines as for recycled fibers and the demand for wood would increase dramatically. Second, publishing firms have to accept mineral oil-free water-based binders. Still, the publishing industry adheres to establish printing processes and mineral oil residues remains in the value chain. Third, the cardboard packaging is coated with a functional barrier against the migration of mineral oil. In this case, the supplier offers such a barrier solution which helps to keep taste and aroma intact while protecting the content from external impacts. One respondent notes: "This barrier confirms a high effectiveness in preventing mineral oil residues from migrating from cardboard packaging into food within the shelf-life of packaged goods".[2] The supplier absorbs the barrier from plastic packaging to cardboard packaging. This innovation offers a new functionality to food processing firms but does not require changes in the production process of cardboard packaging manufacturers.

Case 2: UV Absorber Against Broad-Spectrum UV Radiation in PET Packaging

In Case 2, two suppliers develop at same time an innovation to protect longer and more clearly the content of plastic packaging against ultraviolet (UV) radiation. One supplier is a leading chemical company. His portfolio covers different categories: from chemicals, plastics, performance products, and agricultural products to oil and gas. The second supplier produces and sells specialty chemicals. He serves different major markets such as paper, plastics, printing, and packaging worldwide.

[2] Interview with material supplier (position: Marketing Manager Packaging), 08/17/2011.

Table 6.2 Case study descriptions

Case ID	Final application	Material supplier	Manufacturer	End applicator	Driver of innovation	Innovative solution	Number of interviews
Case 1	Cardboard packaging (food)	Producer of materials for barrier coatings	Producer of cardboard packaging	Two food processing firms	Alarming levels of mineral oil residues from cardboard packaging in food	Functional barrier against mineral oil residues in cardboard packaging	*4 interviews* Material supplier: 1 End applicator: 3
Case 2	Plastic packaging (non-food)	Producer of plastic additives	Producer of plastic packaging	Producer of personal care products	Plastic packaging made of PET is completely transparent in the region of UV wavelengths between 320 to 400 nm; organoleptic problems in packaging occur	UV absorber against broad-spectrum UV radiation in plastic packaging	*4 interviews* Material supplier: 2 End applicator: 2
Case 3	Automotive (interior)	Producer of polyurethanes	Producer of artificial leather	OEM	Amendment of the VOC guidelines; supplier's self-imposed target to eliminate solvents & toxic substances in automotive seating	High-solid dispersion for automotive seating as an alternative to PVC and natural leather	*4 interviews* Material supplier: 2 Manufacturer: 1 End applicator: 1

(continued)

Table 6.2 (continued)

Case ID	Final application	Material supplier	Manufacturer	End applicator	Driver of innovation	Innovative solution	Number of interviews
Case 4	Glass packaging (food)	Producer of sealant compounds	Producer of caps and closures	Food processing firm	Amendment of the Plastics Directive in Europe; migration problem in glass packaging	PVC-and plasticizer-free sealant for metal Twist-off® closures	*5 interviews* Material supplier: 3 Manufacturer: 1 End applicator: 1
Case 5	Automotive (interior)	Producer of polypropylene compounds	Producer of automotive instrument and door panels	OEM	Supplier's self-imposed target to combine soft-touch surfaces with lower system costs and higher recycling potential	PP compound for surfaces of automotive instrument and door panels	*2 interviews* Material supplier: 1 End applicator: 1

The driver of the supplier innovation is that plastic packaging made of polyethylene terephthalate (PET) is completely transparent in the region of UV wavelengths between 320 to 400 nanometers (nm). Consequently, organoleptic problems in packaging occur. In this case, fragrance ingredients are highly sensitive to photodegradation and cause changes in appearance, odor, and functionality of cosmetic formulas. It is the aim of suppliers to create an absorber that blocks broad-spectrum UV radiation but “allows visible light to pass through the package, maintaining transparency” (Coughlin and Schambony 2008, p. 229). It should protect the package appearance and increase the ingredients shelf-life. The new absorber also offers non-yellowing coloration of plastic and high stability of product quality. One respondent notes: “This absorber combines UV protection with an attractive packaging appearance. It offers the balance between blocking the greatest possible range of damaging UV radiation and keeping the transmission in the visible region as high as possible”.[3] In this case, the innovative additive is adapted to plastic packaging. It implies enhanced benefits to producers of personal care products and does not require any changes in the production process of plastic packaging manufacturers.

Case 3: High-Solid Dispersion for Automotive Seating

In this case, the supplier is a global supplier of materials for coatings, sealants, adhesives, and functional films. His business activities are focused on the development and production of resins, called polyurethanes and polycarbonates, used in tough chemical-resistant coatings, adhesives, and foams. The material supplier tries to introduce a new waterborne polyurethane dispersion (PUD) for automotive seating as an alternative to polyvinyl chloride (PVC) leather and natural leather.

The starting point of this supplier innovation is the amendment of the volatile organic compounds (VOC) guidelines in Europe. VOCs are organic chemicals that have a high vapor pressure and low water solubility. The VOC guidelines limit the amount of VOC in certain paints and lacquers for coatings of buildings and vehicle paint repair. In addition, the supplier voluntarily reduces the VOC in automotive interior materials. One important aspect of the PUD is that it is completely free of solvents and toxic substances and lowers the VOC emissions by a factor of 10. One respondent reflects: “The PUD creates polyurethane synthetic leather with the soft feel and resistance properties demanded by OEMs. Besides its chemical properties like good foamability, flexibility, and hydrolytic stability, it is a high-solid dispersion which combines customer benefits: comfort, appearance, feel, and durability of leather. Moreover, coating manufacturers no longer have to apply a multi-stage process that involved the removal of toxic dimethyl formamide (DMF). With the new PUD, performance and sustainability become compatible goals”.[4]

The supplier innovation in Case 3 is an innovation that offers product improvements to OEMs. The supplier adapts the PUD to textile coating in automotive

[3] Interview with material supplier (position: Head of Global Marketing), 10/13/2011.

[4] Interview with material supplier (position: Head of Textile Coating), 07/12/2011.

interiors and provides a new benefit to OEMs without any changes in the production process of manufacturers of artificial leather. Therefore, the coating process can be performed on existing equipment with higher efficiency and less resources.

Case 4: PVC- and Plasticizer-Free Sealant for Metal Twist-Off® Closures
In Case 4, the material supplier is a global producer of plastic compounds used in sealants for caps and closures. In particular, he is a specialist for compounds providing added protection for greasy and oily products (e.g. antipasti) in the food industry.

The key driver of this supplier innovation is an amendment to the Plastics Directive in Europe. To quickly answer to emerging specifications in the value chain, the supplier develops a PVC- and plasticizer-free sealant for metal Twist-off® closures. He adapts the thermoplastic elastomers (TPE) technology in the field of lugs and metal closures. This closure technology is primarily used in crown corks and aluminum closures and enables the elimination of PVC in lug caps with direct food contact. One respondent notes: "By replacing the PVC gasket materials, the migration potential is reduced by a hundredfold. It makes glass containers safer because interactions between the packaging and the contents do not happen. In addition, the compound meets the stringent migration limitations even for oily foodstuffs with longer shelf-lives. Moreover, it ensures compliance with the legal requirements".[5] This highly innovative product protects the health of consumers as well as the odor and taste of packaged food. Other characteristics are good processability, no vacuum losses, and user-friendly resealability.

This compound is a highly innovative product that offers significantly enhanced benefits to food processing firms and applies a substantially new technology. Instead of a full-surface solution, the new technology entails a ring solution for metal closures. The metal caps and closures are equipped with a washer. As a consequence, the development of new machinery is required to inject a washer and not a full-surface compound.

Case 5: PP Compound for Surfaces of Automotive Instrument and Door Panels
In Case 5, the supplier is a global firm for polymers, chemicals, and fuels. The innovation is developed in the organic thermoplastic polymers (i.e. olefins and polyolefins) business unit. It describes a polypropylene (PP) compound that gives a soft aesthetic look to surfaces of automotive instrument and door panels.

The benefit of this innovation is a combination of high-quality surfaces with lower system costs, reduced system complexity, and the support of "green objectives". One of the respondents states: "By achieving a surface quality superior to traditional materials without using paint, this compound establishes new aesthetic and resource efficiency bench marks".[6] In comparison with competitive solutions such as polycarbonate/acrynitril butadiene styrene, the supplier innovation provides

[5] Interview with material supplier (position: Chief Technology Manager), 07/27/2011.
[6] Interview with material supplier (position: Global Marketing Manager), 02/22/2012.

additional advantages for automotive interiors: matt appearance with good scratch resistance and surface robustness, good noise dampening, high quality design, and high recycling potential. This PP compound does not contain softeners and is fully compatible with other polyolefins.

This PP compound primarily reforms the manufacturing process of plastic by eliminating the coating step and thus reducing the manufacturer's sphere of competence. The process technology is an in-reactor alloying process. In contrast to conventional systems, the polymerization reactor technology contains three reactors connected in series. It allows the production of high quality blends in a one step process without losing product quality. This ready to use compound provides a higher freedom of design and flexibility for injection processes.

Overall, the supplier innovation offers the same product functionality. But it provides other benefits like lower production costs, enhanced productivity and product quality, as well as resource efficiency to OEMs by applying a substantially new technology. It uses a unique combination of catalyst, process technology, and monomers.

6.6 Analysis and Results

In the previous section, the different cases are shortly introduced. To analyze the collected data, it has yet to be categorized with respect to recurring patterns and frequently mentioned aspects. The categorization and coding process is illustrated in the next paragraph.

There are numerous ways to analyze data from the case studies. Ellram (1996), for instance, presents three different coding processes: open coding, axial coding, and selective coding. Each of these processes is shortly presented below. The first coding approach, labeled *open coding*, is characterized by methods that are used to break down case study data in order to analyze, conceptualize, and develop categories for the data (see Ellram 1996). The main goal is to summarize segments of data. To summarize the gathered information, it is useful to create a table listing the different cases and the data categories of interest. Ellram (1996, p. 108) states that "open coding is an iterative process that allows the researcher to compare similarities and differences among case studies". The second coding approach, labeled *axial coding*, focuses on interactions and relationships between categories. It describes the step after open coding. This approach should help to deliver a greater insight into the case study data (Ellram 1996). Miles and Huberman (1994) call it "pattern coding" and characterize it by classifying issues that are identified in the first step, and then summarizing these issues into themes in the second step. The third coding approach, labeled *selective coding*, refers to the process of first selecting the central or core category around which the final analysis will be based. Next, the selected category has to be related to other categories in the second step and validated in the third step (see Strauss and Corbin 1990). Finally, existing categories are refined or new categories are developed. Like axial coding, selective coding is an integrative process. Still, the analysis is done on a much higher, holistic level (Ellram 1996). The main goal here is to develop a single storyline that connects all categories.

In this dissertation, the coding process is a combination of open and axial coding. First, words and phrases found in transcripts or notes and further documents are coded. Second, categories by grouping the codes given in words and phrases are developed. Categories are useful to organize the collected data in a clear way (Strauss and Corbin 1990). Therefore, a guideline is created to code the collected case study data. Based on the developed guideline, the content of the interview protocols and additional documents is categorized. In total, seven different categories are established:

- *Initialization:* description of the initial cause of the supplier innovation
- *Product development:* differentiation between adaptation of a present product and totally new product development
- *Product launch:* specification of the actions taken by the supplier to launch his innovative material
- *Product characteristics:* description of the distinctive characteristics of the respective supplier innovation
- *Value Chain Marketing* (*VCM*)*:* explanation of the VCM process and the marketing instruments or activities used by the supplier to implement his innovation along the value chain
- *Implementation:* description of the result of the supplier's marketing attempt to implement his innovation
- *Problems:* clarification of the problems or challenges the supplier is faced with when marketing his innovation

These categories are used to structure the data analysis which is divided into a within-case and a cross-case analysis. As stated by Yin (2009), a within-case analysis is useful to examine integration in a single context, while a cross-case analysis helps to identify patterns across the different cases. A cross-case analysis focuses on interactions and relationships between the defined categories.

In the next two subsections, the results of the within-case and the cross-case analysis are presented in detail.

6.6.1 Within-Case Analysis

The purpose of the first subsection is to present descriptive write-ups. These descriptions offer details of the five cases used in this study. Each case is described based on the defined categories. As recommended by Wu and Choi (2005, p. 32), the researcher strives to describe each case in a way "that is internally consistent and is compiled as objectively as possible with minimal subject interpretations". Each case opens with some background information, it then proceeds to discuss the initialization of the innovation, as well as the product development, launch, and characteristics. In the subsequent VCM process, the specifics of the implementation process and the existing problems are considered. Moreover, each case is accompanied by a visualization of the initialization process.

Case 1: Functional Barrier Against Mineral Oil Residues in Cardboard Packaging

In the first case, the innovation is initialized by high levels of mineral oil residues from cardboard packaging in food. The FSA of Zurich discovers the migration problem by applying a new testing method. It then publishes and distributes the test results. This puts pressure on food processing firms as they have to protect the health of consumers. Reacting to the present value-chain situation, the respective supplier uses his expertise in plastic packaging and falls back on his relationships with food processing firms. This implies that the supplier adapts an existing functional barrier from plastic packaging to cardboard packaging. Figure 6.3 shows the initialization process.

The innovation itself is described by the respondent of the material supplier as "a polyamide that is suitable for use as a barrier coating both for cardboard packaging and as an inner packaging component or a bag-in-box system".[7] It provides food safety and consumer protection by keeping food free from high levels of mineral oil residues. But there are other characteristics, e.g. high process reliability, high perforation resistance, and high aesthetic appeal. In this case, the supplier firm introduces a functionality-driven innovation (see Sect. 3.2). The innovation does not require changes in the manufacturing process. The packaging manufacturer just adds the barrier ingredient to the present formulation. As a result, the implementation of the said supplier innovation takes less time.

To launch the innovation, the supplier starts with a big press release. Then, he uses the leading trade fair for the packaging industry, Interpack 2011, to present the innovation to a big audience. At the fair, the supplier gets in contact with numerous interested food processing firms. Afterward, face-to-face meetings are arranged by making personal calls on interested applicators, i.e. food processing firms. Finally, two applicators invite the material supplier to present the innovation. Due to the high interest of the involved applicators, the supplier transfers a message that advocates the enhanced product functionality and assumes an immediate customer need.

In the first case, the integration of the cardboard packaging manufacturer takes place at a later stage of the VCM process. The material supplier pursues a "non-cooperative strategy".[8] The reason to exclude the manufacturer at the beginning of the process is the direct access of the supplier to food processing firms. He just addresses familiar contact persons who want to solve the migration problem. To target the food processing firms effectively, the supplier involves special VCM staff and presents the relevant information in a customized product flyer. He also offers detailed information on the packaging website and organizes customer days with applicators, i.e. food processing firms. The interviewee of the material supplier

[7] Interview with material supplier (position: Marketing Manager Packaging), 08/17/2011.

[8] Interview with material supplier (position: Marketing Manager Packaging), 08/17/2011.

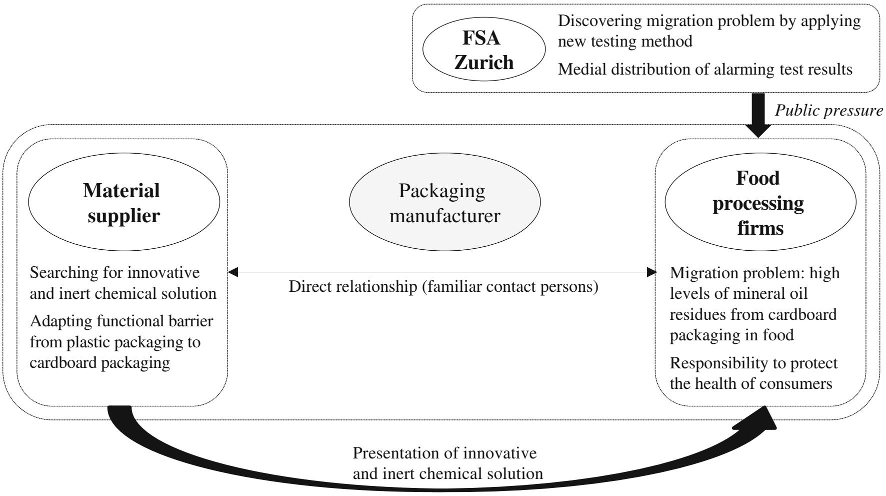

Fig. 6.3 Initialization of Case 1

reflects: "These days help us to receive inside information and translate this information into valuable product improvements and innovations for the packaging industry".[9] To demonstrate the effectiveness of the functional barrier, the supplier develops a prototype and then cooperates with the official FSA in Zurich which confirms the test results. These results increase the supplier's credibility and are used as a strong sales argument.

At a later stage of the VCM process, cardboard packaging manufacturers are integrated to test the suitability of the functional barrier. They certify positive test results and support the implementation of the supplier innovation. Both food processing firms addressed by the supplier accept the barrier solution, but only one of them technically implements it during the data collection process. The other food processing firm goes on testing the recyclability of the functional barrier.

Actually, the supplier does not face big difficulties in the marketing of his innovation. Due to his familiarity with applicators, there are no problems in communication. This implies that the relationship between the supplier and the food processing firm is maintained based on mutual understanding in the chemical, the technical, and the application-related business field. A high overlap between the knowledge bases of the involved actors can be observed and turns out to be a key to success. One respondent of one applicator points out that "the supplier has proven to be a reliable partner over the years—and improved year by year in understanding our needs".[10] This implies that the audience's feeling about the source's competence to speak on the relevant topic is positive. Also, a university degree in chemistry and work experiences in the field of packaging manufacturing helps the applicators to interact with the supplier. The supplier, in turn, knows the application

[9] Interview with material supplier (position: Marketing Manager Packaging), 08/17/2011.
[10] Interview with end applicator (position: Head of Packaging), 08/31/2011.

market and has experience in communicating his knowledge to downstream customers. Still, one applicator criticizes the lack of value pricing as the supplier "only considers a part of the value chain and does not calculate the price impact for the whole product".[11] The interviewee further suggests that the supplier should calculate the total costs for different scenarios and thus delivers a basis for discussion.

Case 2: UV Absorber Against Broad-Spectrum UV Radiation in PET Packaging

In the second case, organoleptic problems in PET packaging require the development of a new plastic additive. These problems occur because packaging made of PET does not absorb the long wave component of UV radiation. One interviewee of the producer of personal care products explains that "one fragrance ingredient causes changes in appearance, odor, and functionality of a cream".[12] For that reason, UV stability of the cosmetic formulation is lacking. But stability is essential to maintain an attractive packaging. Reacting to the present situation, two suppliers adapt one of their UV absorbers from PET packaging. They differ in their firm size and their main goal. The first supplier is a big international firm that does not only produce specialty chemicals but also commodities. He focuses on selling high volumes. The second supplier concentrates on specialty chemicals. His firm size allows offering custom-made solutions. An overview of the initialization process is graphically shown in Fig. 6.4.

A critical argument of the said innovation is the combination of UV protection with an attractive packaging appearance. Additional characteristics are low volatility or migration and excellent photo-permanence. The innovative additive offered by the first supplier is a full-surface solution. This implicates that the entire PET bottle is coated with the new UV absorber. In fact, it is a cost-intensive solution. The second supplier provides a custom-made solution. He first dyes the absorber and afterward coats a transparent film to guarantee a double UV protection of the PET bottle. The transparent film was used before, but it did not offer UV protection. While the innovation offers a new functionality, the production process remains the same. The current chemical solution is simply expanded by the plastic additive. This, in turn, speeds up the implementation of the innovation.

As in the first case study, both suppliers start with a press release. Thereafter, they visit K 2007, an international trade fair for plastics and rubber, to present their innovations. At the same time, the producer of personal care products uses the fair to spread his needs and requirements into the packaging value chain. The two said suppliers react. First, they get in contact with the interested applicator by telephone and arrange on-site visits. Next, the end applicator invites the suppliers to get detailed product information. The first supplier mentions the additional costs of his solution but primarily stresses the new functionality which solves the organoleptic problems in PET packaging. In contrast, the second supplier refers to the new functionality and then focuses on the cost benefit of his custom-made solution compared to the full-surface solution of the first supplier. The respondent of the

[11] Interview with end applicator (position: Head of Corporate Packaging), 09/13/2011.

[12] Interview with end applicator (position: Packaging Development), 10/12/2011.

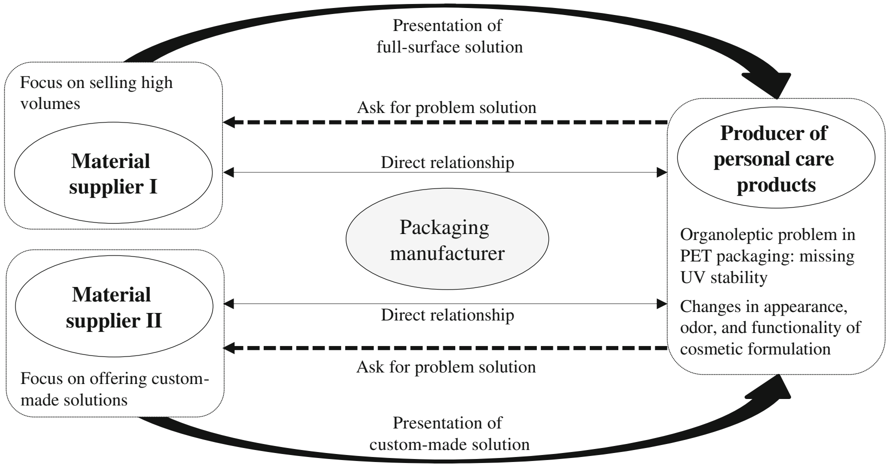

Fig. 6.4 Initialization of Case 2

personal care products argues that "the supplier providing a double UV protection quotes the prices per unit or PET bottle".[13] In other words, the second supplier uses value pricing to convince the relevant applicator.

In this case, both material suppliers leapfrog the packaging manufacturer and thus pursue a "non-cooperative strategy".[14] They integrate the intermediate actor at a later stage of the VCM process. The suppliers decide in favor of non-cooperative VCM due to direct access to customers down the value chain. This familiarity helps them to present their innovative products successfully. Both suppliers engage special VCM staff to embrace producers of personal care products and become familiar with their business process as well as the industry developments and drivers. In addition, they offer customized product brochures and packaging websites to focus on functionality and aesthetics of packaging. This implies that technical details and price information become less relevant.

To target the applicator more successfully, the second supplier develops a tailor-made product form. In that way, the applicator is able to run trials in production and evaluate the product's value proposition on his production lines with real production parameters. After discussing the product variants, the producer of personal care products instructs one packaging manufacturer to test the suitability of both UV absorbers. The packaging manufacturer carries out this instruction. He does not want to place the business relationship with the applicator at risk. He is aware of his weak position in the packaging value chain and certifies positive test results. At the end, the applicator chooses the "film solution" of the second supplier and thus rejects the "full-surface solution" of the first supplier. The respondent of the producer of personal care products reflects: "The film solution perfectly fulfills our needs and requirements by guarantying a double UV protection of the PET

[13] Interview with end applicator (position: Head of Corporate Packaging), 09/13/2011.
[14] Interview with material supplier (position: Head of Global Marketing), 10/13/2011.

cream bottle. Furthermore, it is the more cost-efficient solution".[15] The implementation of the innovation is finished after 2 years.

Overall, both supplier firms communicate effectively with the involved end applicator. They profit from the existing relationship with the producer of personal care products and a high knowledge overlap by sharing common knowledge in all three relevant knowledge fields (chemical, technical, and application related). One of the interviewees of the applicator has a university degree in chemistry and has also worked for a global material supplier. Therefore, the distance between the involved actors is small and the communication is smooth. One interviewee of the producer of personal care products aptly summarizes: "The suppliers are well-informed on the market trends and regulations of the packaging industry. They have expertise in communicating their knowledge to brand owners like us. This is essential to come to an agreement".[16]

Case 3: High-Solid Dispersion for Automotive Seating

In this case, the supplier innovation is not initiated by a problem at the stage of the applicator (see Fig. 6.5). Here, the supplier proactively develops a product to gain a competitive advantage. The supplier's action is inspired by the amendment of the VOC guidelines in Europe. The special aim of the supplier is to translate these guidelines into the automotive interior in order to "set new standards in this application and correspond to future market trends".[17] Moreover, the supplier strives for a solution free of softening agents to protect the health of car drivers. To develop such an inert solution, the supplier adapts the PUD from textile coating in the sports industry and the automotive exterior to the automotive interior.

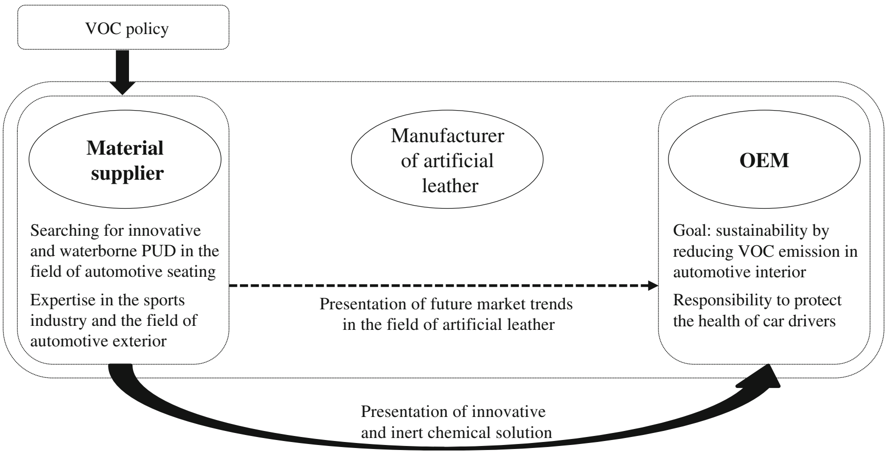

Fig. 6.5 Initialization of Case 3

[15] Interview with end applicator (position: Packaging Development), 10/12/2011.

[16] Interview with end applicator (position: Head of Corporate Packaging), 09/13/2011.

[17] Interview with material supplier (position: Head of Textile Coating), 07/12/2011.

The new PUD creates soft, high-performance synthetic leather with economic and environmental benefits. This is due to the fact that the coating can be applied in a single step and thus increases machine utilization. Moreover, energy consumption is reduced as less water evaporates during the process. One of the respondents of the supplier states: “The new PUD is a more eco-friendly and applicator-friendly option”.[18] He further suggests that this high-solid PUD is easy to mechanically foam, provides flexibility, strength and hydrolytic stability formulators expect, and is resistant to abrasion, chemicals, water, oil, cold temperatures, and repeated washing. The supplier’s product presents a functionality-driven innovation. The coating process is performed on existing equipment with higher efficiency and less resources. The only thing manufacturers have to do is to add the PUD ingredient to the present formulation.

The marketing process of the waterborne PUD is divided into two parts. First, the supplier tries to cooperate with a manufacturer of artificial leather and targets some manufacturers to gain access to OEM business units taking the responsibility for leather in the automotive interior. To convince the manufacturer, the supplier conveys a rather rational message. He points out the advantage from a multi-step to a single-step coating process and presents related cost savings. Moreover, the supplier shows a coated prototype at the Asia Pacific Leather Fair in 2005. This attempt fails as the manufacturers are not able or willing to contact OEMs and stimulate their interest. One primary reason cited for the failure of this cooperative approach is that manufacturers of artificial leather are not used to promote supplier innovations aggressively. One respondent of the material supplier argues: “They stick to their daily routines and prefer to wait until the end applicator verbalizes an urgent need for this kind of innovation”.[19]

Due to the limits of the first marketing attempt, the supplier decides to focus his marketing efforts on OEMs. He starts with a press release and uses the international trade fair devoted to textiles, TechTextil 2011, as a platform to showcase his innovation and get in contact with OEMs. After the industry fair, the supplier tries to find the right contact person at the stage of the OEMs. To gain access, the supplier firm creates a task force which analyzes the OEM market in detail. One of the respondents of the supplier reflects: “It is a challenging task to find the responsible person for textile and leather at the stage of the OEMs. It needs several approaches to establish a first contact.”[20] The starting point here is an on-site presentation about environmental-friendly, low-emission solutions, and future market trends in the field of synthetic leather. The target group of the presentation works for the OEM textile and leather business unit. This presentation acts as the door opener for the PUD project. To support the arguments used in the first presentation, the supplier offers all relevant information in a customized product flyer.

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[18] Interview with material supplier (position: Senior Manager Textile Coating), 09/21/2011.

[19] Interview with material supplier (position: Head of Textile Coating), 07/12/2011.

[20] Interview with material supplier (position: Head of Textile Coating), 07/12/2011.

After approximately 1 year, the OEM initiates a specific project which focuses on environmental-friendly, sustainable solutions in the automotive interior. In consequence, the OEM recalls the supplier's presentation and contacts the supplier by telephone to arrange the first face-to-face meeting with all relevant players: material supplier, manufacturer of artificial leather, and OEM. Next, several meetings follow with all three parties to discuss the details of implementation. In total, the manufacturer of artificial leather tests the technical feasibility of the PUD and accepts the implementation after 7 years.

The communication between the responsible persons of the supplier and the applicator is smooth and face less resistance. In this case, the supplier has technical know-how and is able to formulate innovative solutions. Moreover, he has experience in communicating his knowledge to applicators. In turn, the applicator has experts in his ranks who specialize in the field of artificial leather and hydrocarbons (HC) emissions. The communication partners share common knowledge in different business fields and thus profit from a high knowledge overlap.

Case 4: PVC- and Plasticizer-Free Sealant for Metal Twist-off® Closures
In Case 4, the food industry is faced with a migration problem of PVC in glass packaging. The supplier reacts with an innovation to correspond to the specifications and needs of this industry and to answer to the 4th amendment of the Plastics Directive in direct contact with foodstuffs. "With this directive certain phthalates (plasticizers), which are commonly used in PVC lining compounds, are banned and the use of others is seriously restricted, especially when in contact with high fatty or oily food".[21] The interviewee continues that this directive dictates that the total permitted migration from the packaging (compound) into filling goods must be reduced from 300 mg/kg to a maximum of 60 mg/kg of foodstuffs. To fulfill this limit, the supplier uses his expertise in crown corks to develop a PVC- and plasticizer-free sealing compound for metal Twist-off® closures. Figure 6.6 shows the initialization process.

This innovative compound meets the stringent migration limitations even for fatty or oily foodstuffs with longer shelf-lives. In this case, TPE granulates are used to minimize the potential risks for migration of undesirable substances. One of the respondents of the supplier explains: "TPE granulates are liquefied by using extrusion and are applied directly into the closure. The big advantage is that curing is not necessary, it only requires formation".[22] Other important characteristics are: good processability, no vacuum losses, and user-friendly resealability. Compared to the first three cases, the sealant describes a really new product which offers significantly enhanced benefits to the food processing firm and also applies a substantially new technology. To ensure food safety, the supplier creates an inert solution conform to EU legislation. Instead of a full-surface solution, the supplier develops a ring solution for metal caps and closures. This requires the development

[21] Interview with material supplier (position: CTO), 07/27/2011.

[22] Interview with material supplier (position: Technical Service & Development), 08/30/2011.

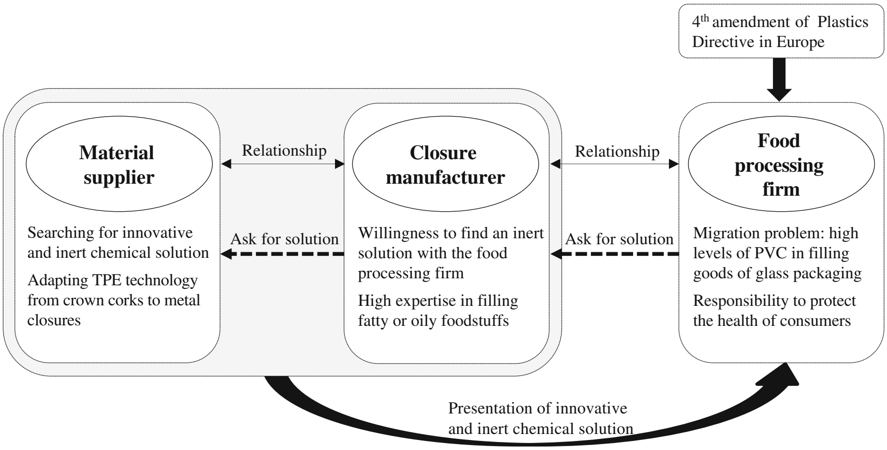


Fig. 6.6 Initialization of Case 4

of new machinery to inject a washer instead of a full-surface compound. The interviewee of the closure manufacturer reflects: "Of course, a ring solution is less costly in the long run. It is economical and sparing to natural resources. But it is very hard to integrate and thus extends the implementation time".[23] The respondent of the food processing firm argues: "All efforts have paid off. The ring solution shows the best possible migration results and minimizes the risk potential for our customers".[24]

To start the marketing process, the supplier exhibits at the leading trade fair for the packaging industry and all related process technologies, Interpack 2008. Then, he targets several closure manufacturers and evokes interest of one of them. He presents the functionality of the PVC- and plasticizer-free sealing compound which solves the migration problem in glass packaging. Thereafter, the manufacturer contacts a familiar producer of gourmet products with an urgent need because 90 % of his products are fatty or oily foodstuffs. Finally, the material supplier and the closure manufacturer jointly target the food processing firm to present the innovative solution in detail. One of the respondents of the supplier reflects: "By cooperating with the closure manufacturer, we are able to describe the functionality as well as the technical implementation of the innovation. It helps us to offer detailed information about the required adaptations of the manufacturing process".[25] After initiating a joint project, all involved parties (i.e. the material supplier, the closure manufacturer, and the food processing firm) search for machinery manufacturers that enable the application of a ring solution. That takes a long

[23] Interview with manufacturer (position: CEO), 09/15/2011.

[24] Interview with end applicator (position: Quality Manager), 09/01/2011.

[25] Interview with material supplier (position: Consultant, previous CEO), 08/30/2011.

time as the potential machinery manufacturers spare the required investments. The technical implementation of the innovation is finished after three and a half years.

To launch the final product, the marketing alliance, i.e. the supplier, the manufacturer, and the applicator, utilizes specific marketing instruments and activities. They start with an extensive press release where they announce joint road shows and symposiums. Next, they visit industry fairs like Interpack and Anuga 2011 to organize talks about intelligent solutions for optimal food protection. They also initialize round tables with experts from science and practice as well as decision makers of the food business sector to discuss the trends and developments of packaging materials which come into contact with foodstuffs. They also launch special project websites and use ingredient branding by creating a PVC-free label printed on the closures for the food processing firm. The respondent of the food processing firm states: "Ingredient branding is useful to get in contact with consumers, to create awareness for the migration problem and the product, to put pressure on the retail market, and to demonstrate the initiative".[26]

At the beginning of the VCM process, there is a big distance between the supplier and the food processing firm. The supplier has to cooperate with the closure manufacturer to gain access to the food processing firm. In the first meeting, the manufacturer acts as a translator to reduce problems in communication. The main problem is that the supplier only uses chemical and technical instead of product-related arguments. The respondent of the applicator notes: "We do not share a common language. Without the integration of the manufacturer, the project would have failed".[27] The supplier is not familiar with the applicator's facilities and does not fully understand the requirements (e.g. the filling process). In consequence, the manufacturer tries to mediate in order to transmit a more appropriate message to the applicator. Besides communication problems, the involved firms have to solve numerous technical problems to implement functioning machinery. To date, a reliable method to measure the true level of migration is still missing.

Case 5: PP Compound for Surfaces of Automotive Instrument and Door Panels

The supplier innovation here is not initiated by public pressure. In fact, it is an in-house development by chance which combines high-quality and soft-touch surfaces with lower system costs, reduced system complexity, and the support of "green objectives". Therefore, "the supplier innovation can answer the permanent cost pressure and sustainable development in the automotive industry".[28] The supplier proactively develops an innovative PP compound, i.e. a soft-touch polyolefin blend for automotive interiors, by using his expertise in polymerization reactor technology. This new blend offers a unique combination of performance

[26] Interview with end applicator (position: Quality Manager), 09/01/2011.

[27] Interview with end applicator (position: Quality Manager), 09/01/2011.

[28] Interview with material supplier (position: Global Marketing Manager), 02/22/2012.

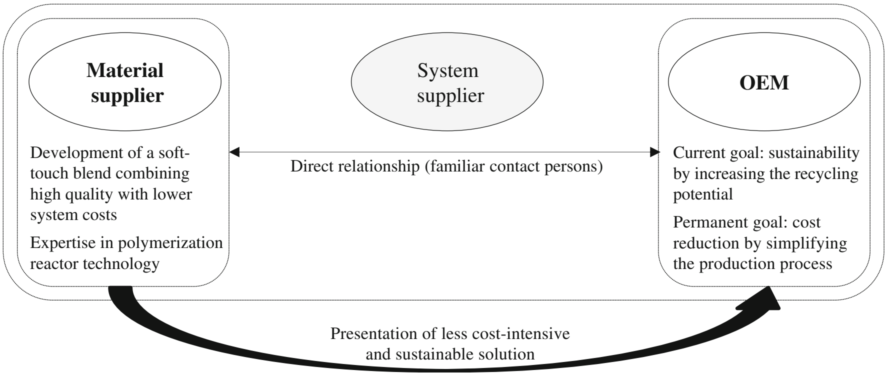


Fig. 6.7 Initialization of Case 5

and processing characteristics. Figure 6.7 graphically summarizes the initialization process of Case 5.

The PP compound is a polymer with an exceptional fine structure. It is a ready to use compound which does not contain any softeners and is fully compatible with other polyolefins. Moreover, it offers soft touch, matt surface, stiffness, chemical resistance, scratch resistance, surface robustness, noise dampening, process simplicity (i.e. simple injection molding process), no design constraints, performance vs. cost, and pleasant haptics. The respondent of the supplier aptly summarizes it as a "one component concept or one step process allowing easy recycling".[29] He continues that "system suppliers can produce interior parts with exceptional surface aesthetics and soft-touch qualities without the need for painting".[30] Here, a process-driven innovation is introduced by the supplier. While the PP compound offers more or less the same product functionality, it is characterized by other benefits such as lower production costs, enhanced productivity and product quality, and recycling potential to OEMs by applying a polymerization reactor technology. Nonetheless, this supplier innovation evokes changes in the manufacturing process. A structuring of the process is needed by eliminating the coating step—a central production step of the manufacturer (i.e. system supplier)—that is typically required when using thermoplastics. It describes a unique combination of catalyst, process technology, and monomers.

To launch the product, the supplier visits different industry fairs and congresses such as Plastics in Motion 2006, Abex 2006, and Jornadas de Plasticos 2007. But the supplier receives the most valuable feedback at the VDI congress in 2007. The respondent of the supplier notes: "This congress acts as the door opener and facilitates the first direct contact with several OEMs".[31] After the first interaction, the supplier makes personal calls to interested OEMs to arrange on-site visits. Next,

[29] Interview with material supplier (position: Global Marketing Manager), 02/22/2012.

[30] Interview with material supplier (position: Global Marketing Manager), 02/22/2012.

[31] Interview with material supplier (position: Global Marketing Manager), 02/22/2012.

Table 6.3 Case study summary

	Case 1	Case 2	Case 3a	Case 3b	Case 4	Case 5
Initialization	***Reactive approach*** Migration problem and new testing method of mineral oil residues	***Reactive approach*** Organoleptic problems in PET due to board-spectrum UV radiation	***Proactive approach*** Voluntary reduction of VOC in automotive seating materials		***Reactive approach*** Migration problem and amendment of Plastics Directive in Europe	***Proactive approach*** Cost pressure and sustainable development in the automotive industry
Product development	Adaptation of existing functional barrier to cardboard packaging	Adaptation of existing UV absorbers to plastic packaging	Adaptation of waterborne PUD to automotive seating		Development of PVC- and plasticizer-free sealing compound	Development of PP compound, a soft-touch polyolefin blend
	Functionality-driven innovation	*Functionality-driven innovation*	*Functionality-driven innovation*		*Really new product*	*Process-driven innovation*
Product launch	Press release Interpack 2011	Press release K 2007	Asia Pacific Leather 2005	Press release TechTextil 2011	Interpack 2008	Press release VDI congress 2007
VCM	***Non-cooperative VCM*** Spread the innovation	***Non-cooperative VCM***	***Cooperative VCM*** Spread the innovation	***Non-cooperative VCM***	***Cooperative VCM***	***Non-cooperative VCM*** Spread the innovation
	Existing access to end applicators (familiar contact persons) *Knowledge overlap*	Existing access to end applicators (familiar contact persons) *Knowledge overlap*	Lack of access to OEMs (BU Artificial Leather & HC Emissions)		Lack of access to food processing firms	Existing access to OEMs (familiar contact persons) *Knowledge overlap*
	1. Discuss with food processing firms at Interpack 2011	1. Producer of personal care products spreads his needs/ requirements	1. Address some coating manufacturers	1. Find the right OEM contact person	1. Address closure manufacturer	1. Discuss with OEMs at international VDI congress 2007

(continued)

Table 6.3 (continued)

	Case 1	Case 2	Case 3a	Case 3b	Case 4	Case 5
	2. Contact some food processing firms by telephone	2. Contact producer of personal care products by telephone	2. Coating manufacturers fail to contact OEM	2. Contact relevant OEM employee by telephone	2. Closure manufacturer contacts food processing firm	2. Contact some OMEs by telephone to arrange face-to-face meetings
	3. Face-to-face meeting with two food processing firms	3. Face-to-face meeting with one producer of personal care products		3. Face-to-face meeting with relevant BU of OEM	3. Supplier and closure manufacturer jointly target food processing firm	3. Face-to-face meeting with OEM
VCM	*Marketing instruments/activities:* • Prototype and test results • VCM staff • Flyer for end application • Packaging website • Customer days and workshops	*Marketing instruments/activities:* • Tailored-made product form • Value pricing • VCM staff • Flyer for end application • Packaging website	*Marketing instruments/activities:* Prototype (carseat)	• On-site presentation • VCM staff • Flyer for end application	*Marketing instruments/activities:* • Laboratory tests • Extensive press release • Roads shows and symposiums • Fairs: Interpack 2011, Anuga 2011 • Ingredient branding • Special project websites	*Marketing instruments/activities:* • New product form • Prototype presentation • Delivery of samples • VCM staff • Value pricing • Symposium
Implementation	Integration of cardboard packaging manufacturers to test suitability	Integration of plastic packaging manufacturer to test suitability		Integration of artificial leather manufacturer to test feasibility	Authorization of two machinery manufacturers	Integration of system supplier to test feasibility
	Positive test results	Positive test results		Positive test results		Positive test results
	• Applicator 1: Implementation	• Supplier 1: Marketing failure	Marketing failure	Marketing success	Marketing success	Marketing success

(continued)

Table 6.3 (continued)

	Case 1	**Case 2**	**Case 3a**	**Case 3b**	**Case 4**	**Case 5**
	• Applicator 2: Acceptance	• Supplier 2: Marketing success				
	Implementation after 2 years	Implementation after 2 years	Implementation after 7 years (in total)		Implementation after 3.5 years	Implementation after 3 years
Problems	No value pricing			No familiar contact person	• Problems in communication • New machinery • Method to measure migration level	

the supplier meets the OEM at his workplace to discuss more details on the soft-touch polyolefin blend for automotive interior. The supplier first advocates the product functionality and aesthetics before stressing the potential cost savings. Leapfrogging the intermediate stage in this case is inevitable as the elimination of the coating step dramatically reduces the system supplier's field of activity. In consequence, the supplier pursues a non-cooperative approach. The system supplier is integrated at a later stage when the technical feasibility has to be tested. The implementation takes 3 years.

Clearly, the supplier also adapts his marketing instruments and activities to announce his innovative PP compound successfully. First, he develops a new product form: granulate which already contains all critical product characteristics. Second, the supplier presents prototypes and delivers samples to demonstrate that high product quality and lower system costs can be combined. Third, he chooses a special VCM team who fully understands the value chain and its players. That also includes quoting prices in industry adjusted units used by OEMs. Finally, the supplier initializes a symposium that deals with polypropylene in automotive engineering. All these marketing instruments help to communicate the value of the innovation more effectively. From the first meeting, the communication between the supplier and the OEM is smooth. They have an established relationship and share common knowledge in all required fields (i.e. chemical, technical, and application related). The interviewee of the OEM reflects: "The supplier is well-informed on the market trends, regulations, and specifications in the automotive interior but also exterior. It creates the ideal foundation to cooperate successfully".[32] Both actors (i.e. the supplier and the OEM) have high expertise in communicating with one another.

As a transition into the cross-case analysis, a summary of key points observed in the within-case analyses is provided in Table 6.3.

6.6.2 *Cross-Case Analysis*

The purpose of the second subsection is to identify patterns in the use of VCM across the five different cases. A cross-case analysis is required to compare and contrast the patterns that emerge from the detailed case write-ups (see Yin 2009; Eisenhardt 1989; Benbasat et al. 1987). As Doty and Glick (1994) point out, each pattern describes an ideal type that simply indicates a theoretical relationship between the different factors. The authors suggest that the relationships between these factors have to fit at the same time for each pattern. Eisenhardt (1989) states that this kind of analysis helps to understand the phenomenon of VCM beyond each individual firm's context and increases the generalizability of the interpretations. In order to facilitate the cross-case analysis, the data are categorized by cutting and

[32] Interview with end applicator (position: Engineering Manager), 02/22/2012.

pasting the huge amount of data. At the end of this process, there are four factors that are critical to describe the different patterns in the use of VCM: (1) the urgency of a supplier innovation, (2) the newness of innovation, (3) the knowledge overlap between the supplier and the end applicator, and (4) the VCM strategy.

The interview partners first distinguish between a reactive and a proactive approach. In the case of a reactive approach, there is a high degree of urgency at the stage of the applicator. The material supplier just reacts to solve the problem the applicator is confronted with (cf. Case 1, 2, and 4). If a supplier innovation is not initiated by a problem of the applicator, the supplier proactively develops a product to gain a competitive advantage (cf. Case 2 and 5). Another distinctive criterion of a supplier's marketing attempt is the degree of newness that characterizes a supplier innovation. In three of the cases, the supplier tries to implement a functionality-driven innovation. There is also one really new product (cf. Case 4) and one process-driven innovation (cf. Case 5). Finally, the five cases differ with respect to the familiarity with applicators. As described in Case 1, 2, and 5 (see Sect. 6.6.1), the suppliers have direct access to downstream customers and simply address familiar contact persons. This direct access, in turn, coincides with the knowledge overlap between the supplier and the applicator. In Case 1, 2, and 5, the supplier and the applicator share a big amount of common knowledge and thereby profit from a high knowledge overlap. In Case 4, the supplier selects cooperative VCM to overcome the big knowledge distance to the applicator.

Throughout the discussions, the respondents often highlight that there are two different VCM strategies: non-cooperative VCM and cooperative VCM. Non-cooperative VCM is characterized by a late integration of the manufacturer. As shown in Sect. 5.2, it equals the description of the autonomous approach where the manufacturer only takes a passive part in the VCM process. The supplier directly targets the applicator and the latter convinces the manufacturer of adopting the innovation without previously consulting him. As a result, this VCM strategy diminishes the risk of manufacturers' resistance, but it offers a high 'breeding ground' for communication problems because only the supplier sends the innovative message to the respective applicator. He tries to transmit an appropriate message to overcome the distance to the applicator. As mentioned in Sect. 6.6.1, suppliers often decide in favor of non-cooperative VCM if they have direct access to applicators.

Cooperative VCM, in turn, is characterized by an early integration of the manufacturer and requires his active participation. In studies of Rudolph (1989) and Unger-Firnhaber (1996), this strategic approach is called synergetic multi-stage marketing. Even if manufacturers often hamper innovations, suppliers must gain their support. As described in the Case 3a and 4 (see Sect. 6.6.1), the supplier integrates the manufacturer to gain access to customers down the value chain. He wants to reduce the distance to the applicator and thereby increases the overlap between their knowledge bases, which in turn facilitates the communication and interaction process. The manufacturer contributes expertise such as technical know-how to address the technical feasibility of an innovation. Furthermore, some supportive manufacturers share information and experience about familiar downstream customers. Still, they try to remain the main channel of communication between supplier and downstream customer. As stated by Hillebrand and Biemans (2011), these manufacturers act as a proxy for customers down the value chain and thus staying in control of the business relationship. Other manufacturers tolerate direct access to end applicators. In the case of cooperative VCM, the innovative message is jointly sent by the material supplier and the manufacturer. Both actors transmit information on the innovation's benefit and its technical feasibility.

To identify different patterns in the use of VCM, each case is examined in relation to the aforementioned factors. In fact, four different patterns can be defined. They are summarized in Table 6.4 and are explained below.

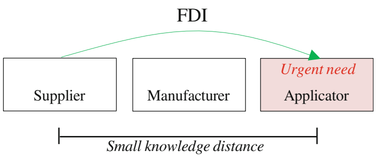
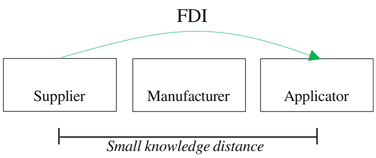
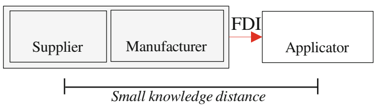
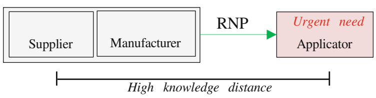
The *first pattern* describes a marketing attempt where a supplier tries to implement a functionality-driven innovation via non-cooperative VCM. As stated in Sect. 3.2, this type of innovation involves the implementation of a new supplier product with enhanced functionality but does not require changes in the manufacturing process. With respect to the five cases, Case 1 and 2 correspond to the first pattern. The difference between these two cases is that in Case 2 two suppliers develop at the same time an innovative product solution. In both cases, the applicator articulates an urgent need. To correspond to the applicator's need, the supplier reacts by absorbing an existing product from one application field and transmits it to a new application field. Due to familiar contact persons, the supplier directly targets the applicator and thus leapfrogs the manufacturer. Despite the distance in the value chain they communicate effectively due to the high knowledge overlap or small knowledge distance. There are no problems in communication since the supplier and the applicator have high expertise in communicating with each other. At the end, the supplier implements his present innovation successfully.

A slight variation of the first pattern can be observed in Case 3b. Here, the final applicator does not formulate an urgent need. Nevertheless, the supplier proactively creates a new product to set new standards in the application field and correspond to future market trends. All other parameters (newness of innovation, knowledge overlap) have the same value. In all three cases, non-cooperative VCM is proven to be the right VCM strategy.

The *second pattern* describes a marketing attempt where one supplier tries to implement a functionality-driven innovation via cooperative VCM. It is applicable in Case 3a. The problem here is that the manufacturer (i.e. system supplier) is either unwilling or unable to aggressively promote the supplier innovation that is not directly required by the applicator. He fails to contact the OEM. As a result, the supplier innovation remains with the manufacturer because he prefers to wait until he receives strong signals from OEMs indicating the need for the said innovation. The supplier makes much effort to cooperate with the manufacturer, but at the end the attempt to implement the innovation fails. Accordingly, the cooperative VCM strategy is ineffective in this case.

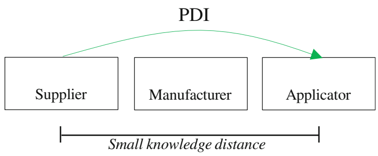
The *third pattern* characterizes a marketing attempt where a supplier tries to implement a really new product via cooperative VCM. This type of innovation offers a new functionality to the relevant applicator but also requires changes in the manufacturing process. In relation to the VCM projects, Case 4 shows the

Table 6.4 Summary of case study patterns

Pattern	Applicable cases	Parameter values	Visualization
I.1	Case 1 Case 2	Reactive approach (urgent need) Functionality-driven innovation (FDI) Non-cooperative VCM (nc-VCM) Small knowledge distance *Acceptance of innovation*	
I.2	Case 3b	Proactive approach (no urgent need) Functionality-driven innovation (FDI) Non-cooperative VCM (nc-VCM) Small knowledge distance *Acceptance of innovation*	
II	Case 3a	Proactive approach (no urgent need) Functionality-driven innovation (FDI) Cooperative VCM (c-VCM) Small knowledge distance *Rejection of innovation*	
III	Case 4	Reactive approach (urgent need) Really new product (RNP) Cooperative VCM (c-VCM) High knowledge distance *Acceptance of innovation*	

(continued)

Table 6.4 (continued)

Pattern	Applicable cases	Parameter values	Visualization
IV	Case 5	Proactive approach (no urgent need)	
		Process-driven innovation (PDI)	
		Non-cooperative VCM (nc-VCM)	
		Small knowledge distance	
		Acceptance of innovation	

parameter values that describe Pattern III. Here, the applicator is proactively searching for an innovative solution to enable the functionality needed. To solve the urgent applicator's problem, a supplier reacts and develops a new compound. As the supplier has no familiar contact person at the stage of the applicator, he pursues cooperative VCM. The supplier first addresses the manufacturer to gain his support because he has an existing relationship with the applicator. Next, both actors jointly target the applicator to present the innovation. Due to the small knowledge overlap or high knowledge distance between the supplier and the applicator, the manufacturer acts as a mediator or translator. This implies that the manufacturer reduces the big distance between them and eliminates problems in communication. In this case, cooperative VCM is the right strategy to implement the supplier innovation successfully.

The *fourth pattern* describes a marketing attempt where one supplier tries to implement a process-driven innovation via non-cooperative VCM. This type of innovation requires fundamental changes in the production process. While it provides more or less the same product functionality, it offers other benefits to the applicator such as enhanced resource efficiency and sustainability. The applicator does not have an urgent need. He just formulates the general goal of sustainability. Here, the supplier firm proactively develops a new product. In Pattern IV, the supplier decides to pursue non-cooperative VCM. This pattern is applicable in Case 5. Both the supplier and the applicator communicate effectively because of a high knowledge overlap. Furthermore, they have high expertise in communicating with each other. Finally, the supplier implements his innovation successfully.

6.7 Discussion of Findings and Research Hypotheses

In the previous section, the contextually rich case study data and their interpretations specific to each case are presented in detail. This step is essential to discuss the cross-case issues where different patterns are derived from data interpretation.

Using five cases, four different patterns of VCM projects are identified. These patterns capture the intricacies of a supplier's marketing attempt to implement an innovation and make implicit reference to marketing performance issues. Based on the cross-case analysis, a discussion of the central findings follows and several research hypotheses are derived. These hypotheses reflect the proposed patterns, specifically with respect to the interaction between the newness of innovation and the VCM strategy as well as the knowledge overlap and the VCM strategy. Figure 6.8 summarizes the hypothesized relationships.

In the case study, the data are gathered and analyzed with the aim of identifying factors that influence the marketing effectiveness of a supplier's attempt to implement an innovation. The analysis shows that there are three key factors that enable or inhibit the implementation of supplier innovations: VCM strategy, newness of innovation, and knowledge overlap. The analysis further suggests that the identified factors are interrelated, creating complex relationships. In the next paragraphs, each factor is discussed in more detail.

6.7.1 VCM Strategy

As noted earlier in this study, material suppliers approach the value chain by dealing with their immediate customers and essentially pushing their innovations into the value chain. But immediate customers often have very low incentives to accept and adopt supplier innovations due to the perceived market risk for products using the new supply. The pilot and the case study results deliver a first indication of the dismissive attitude of immediate customers toward supplier innovations (cf. Chap. 5 and this chapter). If downstream customers do not articulate an urgent need for a specific supplier innovation, immediate customers are unwilling to support the implementation of the innovation aggressively. This implies that the innovation remains with the intermediate stage. In these cases, push marketing is ineffective and inefficient to implement supplier innovations. It results in a low success rate as well as high implementation costs and numerous marketing attempts.

To break through immediate customers' innovation resistance, some suppliers already pursue VCM. They enlarge their target group beyond their immediate customers and address their downstream customers as well. The pilot results support this observation. As presented in Chap. 5, VCM is highly relevant and frequently used in the coating industry. This strategic approach is more successful due to the protagonistic attitude of downstream customers toward supplier innovations. They are motivated to support supplier innovations, at least in cases in which they would highly benefit from such innovative solutions themselves.

The comparison of the five cases brings out that supplier firms have the choice to pursue cooperative VCM (cf. Case 3a and 4) or non-cooperative VCM (cf. Case 1, 2, 3b, and 5) to promote and implement their innovations. As already stated in the pilot interviews, there is a preference for non-cooperative VCM. This strategy allows suppliers to leapfrog manufacturers and reduce their dependence on derived demand or manufacturers. If suppliers already have direct access to applicators, they often prefer non-cooperative VCM. The reason behind is that applicators are open to supplier innovations and are prepared to take risks. They are continually searching for opportunities to maintain sustainable competitive advantage and value the supplier as an important source of innovation. In fact, the case study results indicate that suppliers can also promote and implement innovations for which applicators do not articulate an urgent need by pursuing non-cooperative VCM (cf. Case 3b and 5). In these cases, suppliers address future or distant needs of applicators and provide them a possibility to meet new marketplace opportunities.

If suppliers lack direct access to downstream customers, they early integrate the manufacturer and thus pursue cooperative VCM (cf. Case 3a and 4). But the downside of this approach is that it includes a high risk of manufacturer's innovation resistance (see Sect. 3.3.1). This means that manufacturers only support a supplier's marketing attempt if the applicator verbalizes an urgent need for the said innovation. If this criterion is not fulfilled (cf. Case 3a), the manufacturer usually hampers the implementation of the supplier innovation as long as the applicator indicates a need for it. Manufacturers are often risk-averse. They satisfy applicators' expressed needs but neglect their future needs.

Concerning the relationship between a firm's business strategy and its performance results, the marketing literature presents some evidence (see Morgan et al. 2009; Cooper et al. 1994; Cooper 1984). In particular, market orientation has often been shown as a key predictor of new product performance (see Zhang and Duan 2010; Mavondo and Farrall 2003; Gatignon and Xuereb 1997; Slater and Narver 1994; Day 1990; Kohli and Jaworski 1990; Narver and Slater 1990). Some researchers divide the market-orientation construct into complementary approaches, the proactive or market-driving approach and the responsive or market-driven approach (Narver et al. 2004; Hills and Sarin 2003; Jaworski et al. 2000; Kumar et al. 2000). In the case of a responsive approach, a firm puts its effort into understanding and satisfying expressed or current needs of customers. In contrast, a proactive approach focuses on discovering, understanding, and satisfying latent or future needs of customers. Compared to expressed needs, latent needs "are not in the consciousness of the customer" (Narver et al. 2004, p. 336). They can be observed by thoroughly observing customer behaviors to enable implications for customer problems and possible solutions (Narver et al. 2004; Leonard and Rayport 1997; Hamel and Prahalad 1994). Importantly, these two approaches are not on opposite ends of a continuum. They are independent of each other, suggesting that firms can pursue both approaches simultaneously (see Slater and Mohr 2006; Narver et al. 2004). Recent research has shown that both a responsive and a proactive market orientation have a positive effect on new product performance. But a proactive strategy is related more strongly with new product success than is a responsive approach (Atuahene-Gima et al. 2005; Narver et al. 2004).

Transferred to the VCM phenomenon, a supplier can only correspond to current or expressed needs of downstream customers when pursuing cooperative VCM. The reason is that a manufacturer is integrated at the early beginning of a VCM process. He only supports a supplier's marketing attempt if the respective applicator articulates an urgent need for this specific innovation. In other words, a manufacturer expects that the said supplier innovation fully corresponds to the expressed needs of an applicator. If there is just a partial match, the innovation remains with the manufacturer. This implicates that cooperative VCM only allows a responsive market orientation. Due to the dismissive attitude of manufacturers, latent or future needs of downstream are not taken into consideration. Manufacturers just feel compelled to satisfy expressed needs of applicators.

If suppliers pursue non-cooperative VCM, they are able to correspond to expressed and future needs of downstream customers. This is based on the fact that applicators are targeted first and manufacturers are integrated at a later stage of the VCM process. In contrast to manufacturers, applicators are characterized by a protagonistic attitude toward supplier innovations. They are also open to innovations that anticipate evolving needs to respond rapidly to early signals of environmental changes and meet new marketplace opportunities. Thus, applicators do not expect that supplier innovations fully correspond to their needs or goals. In a nutshell, non-cooperative VCM allows suppliers a proactive dialogue with applicators and thus the combination of responsive and proactive market orientation.

As a result, a central hypothesis here is that non-cooperative VCM plays an important role in marketing supplier innovations. It is related more strongly to the performance of a supplier's marketing attempt than is cooperative VCM. In this dissertation, performance is measured in terms of marketing effectiveness (i.e. the rate of successfully implemented innovations) and marketing efficiency (i.e. money and time invested in a supplier's marketing attempt) (Sheth and Sisodia 2002).

Although the studies cited here are not referring to the VCM phenomenon and the implementation of supplier innovations, it is expected that:

Hypothesis 1: The VCM strategy has an impact on the effectiveness of a supplier's marketing attempt to promote and implement an innovation. Compared to cooperative VCM, non-cooperative VCM is the more effective VCM strategy.

Hypothesis 2: The VCM strategy influences the efficiency of a supplier's marketing attempt to promote and implement an innovation. Compared to cooperative VCM, non-cooperative VCM is the more efficient VCM strategy.

Hypothesis 2a: By using non-cooperative VCM, suppliers speed up the implementation of their present innovation. They have to invest more time to perform cooperative VCM successfully.

Hypothesis 2b: The usage of non-cooperative VCM results in lower implementation costs. As a result, suppliers have to invest more money to perform cooperative VCM successfully.

6.7.2 Newness of Innovation

Supplier innovations are characterized by a certain degree of newness (cf. Sect. 3.2). In this thesis, there are two dimensions of newness. The first dimension of newness defines the newness as perceived by the final applicator. It incorporates changes in the functionality of a final product (e.g. artificial leather for automotive seating). The second dimension of newness refers to the newness as perceived by the manufacturer. It expresses changes in the production process of suppliers' immediate customers (e.g. elimination of the coating step). These two dimensions lead to four types of innovation: incremental innovation, process-driven innovation, functionality-driven innovation, and really new product.

The comparison of the five cases shows that suppliers try to implement process-driven innovations (cf. Case 5), functionality-driven innovations (cf. Case 1, 2, and 3), or really new products (cf. Case 4). Functionality-driven innovations involve the implementation of supplier materials with a new or enhanced product functionality. This type of innovation does not require changes in the manufacturing process of suppliers' immediate customers. Based on the case study results, applicators highly value the effect of new functionalities. They proactively demand this kind of innovation to correspond to consumers' needs. Regarding the cases, an applicator accepts a functionality-driven innovation for the following reasons: to provide an inert solution and thus protect the health of consumers (cf. Case 1), to guarantee a stable product quality (cf. Case 2), and to set market trends by offering an eco-friendly solution (cf. Case 3). As discussed in Sect. 3.3.3, applicators are characterized by an application-driven or symbolic knowledge base. They mainly focus on functionality and aesthetics of final products, as well as market trends and regulations. This implicates that applicators are able to assess the benefit of functionality-driven innovations and frequently accept this type of innovation.

Process-driven innovations comprise the adaptation of the production process of manufacturers. Although process-driven innovations offer more or less the same product functionality, they can provide other benefits to final applicators, e.g. lower production costs, enhanced productivity, resource efficiency, and sustainability. These additional features can arouse applicators' interest (cf. Case 5). But this is the exception rather than the rule. Usually, applicators have difficulties in assessing the benefit of process-driven innovations. They primarily strive toward a deep understanding of their application field. Thus, the domain of process technology is not a focused domain of applicators. Consequently, they show only modest reactions on process-driven innovations.

Really new products provide a new functionality to the relevant applicator but also require changes in the production process of the involved manufacturer. In fact, applicators realize that sometimes a new or enhanced product functionality can only be achieved in combination with a new process technology. Should this be the case, they proactively ask for this type of innovation. Regarding the five cases, this situation is observed in Case 4 where the development of new machinery is required to solve the applicator's migration problem. To clarify the changes in the process technology, the supplier has to invest some time in it. This, in turn, implies that the supplier can spend less time to present the central feature for the applicator, i.e. the new product functionality. In consequence, the supplier has much more difficulty convincing the applicator. The point to be made here is that applicators can assess the value of a new functionality but are usually unable to anticipate the technological risk of a new process. That is why really new products are not as successful as functionality-driven innovations.

The argumentation of the last three paragraphs offers strong support for Proposition I: The design and marketing effectiveness of a VCM process depends on the newness of the supplier innovation.

Concerning the adoption and diffusion literature, the distinction of degrees of newness has produced several streams of research (Song and Parry 1999). One stream focuses on the relationship between newness of innovation and product performance. However, there is disagreement as to this relationship. A first group of researchers suggests positive effects of product innovativeness on new product performance (see Zhou 2006; Zhou et al. 2005; Berth 2003; Song and Montoya-Weiss 1998; Gatignon and Xuereb 1997; Firth and Narayanan 1996; Booz, Allen & Hamilton 1982). A second group predicts negative effects of product innovativeness on product performance (see Min et al. 2006; Danneels and Kleinschmidt 2001; Ali 2000; Atuahene-Gima 1996; Yap and Souder 1994; Meyer and Roberts 1986). A third group finds that the relationship between product innovativeness and new product performance is U-shaped (Avlonitis et al. 2001; Kotzbauer 1992; Kleinschmidt and Cooper 1991).

In contrast to Kleinschmidt and Cooper (1991), Kotzbauer (1992) suggests an inverted U-shaped relationship between product innovativeness and new product performance. He develops an explanatory model of the optimal level of newness from a consumer-oriented perspective. His model shows that an increasing product innovativeness results in both an expectation of increasing advantages (assumption of benefit) and disproportionately increasing acceptance risks (importance and probability of negative buying consequences). If the potential customers are risk-averse, Kotzbauer (1992) discusses the existence of an optimal level of newness. In a nutshell, the chance for product success increases with an increasing level of product innovativeness up to the point of a maximum perceived benefit. If this point is exceeded, the chance of success decreases. Avlonitis et al. (2001) confirm the findings for service instead of technical innovations.

With respect to the VCM phenomenon, the optimal degree of newness from an applicator-oriented perspective is expected if suppliers try to promote functionality-driven innovations. In these cases, applicators are able to assess the advantages of the supplier innovation. They do not perceive any acceptance risks. As a result, the chance for suppliers to effectively and efficiently implement their functionality-driven innovations is relatively high. The situation is different if suppliers provide process-driven innovations. Here, the probability of marketing success is uncertain. Applicators do not proactively demand this kind of innovation and have problems in assessing the advantages of a new process technology. Consequently, they associate acceptance risks with process-driven innovations. In the case of really new products, applicators are able to assess the benefit of a new functionality, but they have difficulties in anticipating the value of a new process technology. This implicates that applicators perceive some acceptance risk with really new products.

The chance for suppliers to effectively and efficiently implement really new products is between that of process-driven and functionality-driven innovations.

Although none of the studies cited here consider the newness from the perspective of suppliers' immediate and downstream customers, the argumentation in the previous paragraphs yields to the following hypotheses:

Hypothesis 3: The newness of supplier innovation has an impact on the marketing effectiveness. The more the supplier innovation focuses on the functionality aspect and thus on the core business of the end applicator, the higher the marketing effectiveness.

Hypothesis 4: The newness of supplier innovation has an impact on the marketing efficiency. The more the supplier innovation focuses on the functionality aspect and thus on the core business of the end applicator, the higher the marketing efficiency.

Hypothesis 4a: The more the supplier innovation focuses on the functionality aspect, the lower the implementation time.

Hypothesis 4b: The more the supplier innovation focuses on the functionality aspect, the lower the implementation costs.

6.7.3 Newness of Innovation and VCM Strategy

The next hypothesis is empirically based on the pilot and case study results. These results indicate that non-cooperative VCM is the less sensitive and less restrictive VCM strategy. This strategy focuses on the downstream stage of a value chain. As mentioned in Sect. 6.7.1, applicators are continually searching for opportunities to maintain sustainable competitive advantage. They also accept innovations for which they do not articulate an urgent need (see Case 5). In other words, applicators support innovations that partly correspond to their needs. As a result, applicators also accept process-driven innovations and really new products even if they mainly ask for functionality-driven innovations.

In cooperative VCM, suppliers first address immediate customers. These customers are characterized by an antagonistic attitude toward supplier innovations. In fact, they expect that the focal innovation fully corresponds to the applicator's needs. If there is just a partial match (i.e. the applicator does not formulate an urgent need), the supplier innovation remains with the manufacturer (cf. Case 3a). Therefore, manufacturers always hamper the implementation of process-driven innovations as applicators would never ask for this kind of innovation. Most really new products also rest with the manufacturer. Only a supplier innovation that focuses on product functionality is passed since applicators proactively demand it. As a result, cooperative VCM is the more sensitive and restrictive VCM strategy. The performance of this strategy is highly influenced by the newness of supplier innovation.

In Case 5, the supplier pursues non-cooperative VCM to implement a process-driven innovation which requires a reformation of the manufacturing process by eliminating the coating step—a central production step of the manufacturer. As the elimination dramatically reduces the manufacturer's field of activity and the applicator does not proactively demand this innovative solution, the supplier selects non-cooperative VCM to promote it. Otherwise, he would not overcome the first barrier of arousing interest in the value chain. Without doubt, it is difficult to overcome the second barrier of implementing the innovation (i.e. fulfill the applicator's expectations), but the chance for supplier to be successful is much higher than in the case of cooperative VCM.

In Case 4, the supplier pursues cooperative VCM to implement a really new product. Here, the applicator is primarily interested in the new functionality but he also knows that the desired functionality can only be achieved in combination with a new process technology. Thus, the applicator proactively searches for a combined solution and forces the supplier and the manufacturer to deal with the urgent problem. To offer an ideal solution, the supplier and the manufacturer cooperate. In this case, the supplier highly depends on the manufacturer's support as he has no direct access to the downstream stage. The manufacturer, in turn, has a close relationship with the relevant applicator and specializes in the field of production processes.

In Case 1 and 2, the supplier pursues non-cooperative VCM to implement functionality-driven innovations. In both VCM cases, the applicator articulates an urgent need. Thus, the first barrier of arousing interest does not exist. Moreover, the supplier and the applicator are not confronted with problems in communication. They have known each other for some time and are used to communicate with one another. Without this direct access to downstream customers, it would be difficult to overcome the second barrier. Here, cooperative VCM could also be an appropriate strategy. The intermediate stage is informed on the urgent need of the applicator. This urgent need does not exist in Case 3 and negatively influences the performance of cooperative VCM (cf. Case 3a). After numerous attempts to gain the support of the intermediate stage, the supplier decides to directly address the applicator and thus pursues non-cooperative VCM (cf. Case 3b).

Taken together, these arguments lead to the following hypotheses:

Hypothesis 5: The impact of the newness of innovation on marketing effectiveness is higher in the case of cooperative than in the case of non-cooperative VCM attempts.

Hypothesis 6: The impact of the newness of innovation on the marketing efficiency is higher in the case of cooperative than in the case of non-cooperative VCM attempts.

Hypothesis 6a: The impact of the newness of innovation on the speed of implementation is higher in the case of cooperative VCM attempts.

Hypothesis 6b: The impact of the newness of innovation on the implementation costs is higher in the case of cooperative VCM attempts.

6.7.4 Knowledge Overlap

Suppliers, manufacturer, and applicators are characterized by different knowledge bases due to their respective position in the value chain (cf. Sect. 3.3.3). Suppliers mainly focus on scientific/chemical knowledge. They have special know-how in the field of chemical composition, structure, and properties of substances and ingredients. Manufacturers focus on technical/applied knowledge and are experts in the field of formulation and conversion of materials. They are highly interested in the physical production process and the testing of final solutions. Applicators concentrate on product-related/user knowledge and specialize in the domain of product functionality and aesthetics. They are mainly oriented toward a deep and complete understanding of their application field to fulfill user needs and expose market trends. To communicate effectively, suppliers, manufacturers, and applicators already have or try to acquire some knowledge in the surrounding fields. Thus, they have some common ground or shared knowledge. But the extent of knowledge they share varies from case to case.

The comparison of the cases shows that the implementation of supplier innovations is influenced by the communication effectiveness, which in turn depends on the knowledge overlap or distance between the involved value-chain actors. If these actors share sufficient knowledge in the domains relevant to the innovation, their knowledge bases overlap and enable a smooth communication (see Case 1, 2, 3b, and 5). Briefly, employees of applicator firms, for example, possess a university degree in chemistry and have worked for a supplier or manufacturer firm. Marketing managers of supplier firms, in turn, know the market trends and regulations and have experience in communicating their knowledge to downstream customers in different applications. But if there is no common ground, the knowledge distance between the supplier and the applicator is too big to communicate effectively (cf. Case 4). Consequently, problems in communication occur and negatively influence the final result of a supplier's marketing attempt.

The argumentation of the foregoing paragraphs supports Proposition II: The design and effectiveness of a VCM process depends on the overlap between the knowledge bases of the involved value-chain actors.

In the extant literature, several authors suggest a close relationship between knowledge overlap and communication effectiveness (see Wu and Keysar 2007; Alavi and Leidner 2001; Clark 1985; Rogers 1983; Clark and Marshall 1981). Fussell and Krauss (1989) predict that the more closely the source's knowledge base overlaps with that of the receiver in the domain relevant to a message, the smoother the communication will be. The authors further suggest that failures in communication partially occur due to the source's inability to correctly evaluate the receiver's knowledge base, either because they lack information about it, or because of mistakes in their mental processes.

In the context of acquisition, Ahuja and Katila (2001) predict that relatedness between the acquired and acquiring knowledge bases is likely to have a nonmonotonic influence on the subsequent innovation performance of acquiring firms. It implies that innovation output will increase with increasing knowledge relatedness. But beyond some optimum, innovation output will decrease with increasing knowledge relatedness. This inverted U-shaped relationship is described previously by Rindfleisch and Moorman (2001), Lane and Lubatkin (1998), Singh and Montgomery (1987), and Lubatkin (1983). Furthermore, Prabhu and colleagues (2005) confirm the nonlinear, inverted U-shaped relationship between knowledge similarity or relatedness and innovation. They find that greater similarity between the acquirer and the target will make it easier for the acquirer to absorb the knowledge of the target firm. They continue that similarity can lead to easier postacquisition of key inventors and thus greater innovation. On the other hand, too much similarity or relatedness leads to overlapping and redundant research and thus offers fewer opportunities for combining different types of knowledge.

In the context of innovation alliance, Cowan and Jonard (2009) suggest an inverted U-shaped relationship between knowledge overlap and innovation alliance. The authors explain that joint innovation involves two firms that combine their knowledge bases to create new knowledge. The knowledge bases of the focal firms are located at different points in some underlying knowledge space. Thus, the distance between the involved actors can play an important role. Based on the work of Grant (1996) as well as Nooteboom (2000), Cowan and Jonard (2009) further suggest that there is little point in sharing if the overlap between the knowledge bases of the firms is too big. But if the knowledge overlap is too small, problems of understanding occur. This relationship is also supported by other authors (see e.g. Schoenmakers and Duysters 2006; Mowery et al. 1998, 1996).

In the context of innovation and learning, the findings of Nooteboom (1999) indicate an inverted U-shaped relationship between knowledge or cognitive distance and learning effectiveness. The author shows that learning is most effective at a distance which is neither to large nor too small. Furthermore, Sapienza et al. (2004) suggest that the efficiency of learning is regulated by the overlap between the knowledge bases of the firms that are involved in the learning relationship. More precisely, they show that the growth of a spin-off firm is maximized if the overlap between the knowledge bases of the spin-off firm and the parent firm is partial. This means that too small knowledge overlap hampers the assimilation of external knowledge and too great knowledge overlap hampers the creation of new knowledge.

Although none of these studies cited here are referring to the phenomenon of VCM and the implementation of supplier innovations, it is expected that:

Hypothesis 7: The overlap between the firms' knowledge bases will influence the effectiveness of a supplier's marketing attempt to implement an innovation either positively (linear relationship) or nonmonotonically (inverted U-shaped relationship).

6.7.5 Knowledge Overlap and VCM Strategy

The next hypothesis is also based on the pilot and case study results. As mentioned, the results show that non-cooperative VCM is the less sensitive and less restrictive marketing strategy. In non-cooperative VCM, only the supplier sends the innovative message to the applicator. He tries to transmit an appropriate message to overcome the distance to the applicator. During the interviews, the respondents of the applicators state that they do not expect a "perfect message" or a very high knowledge overlap. They take into consideration that not all suppliers are used to communicate with customers down the value chain. They know that this is not their daily business, but they perceive suppliers as an important and attractive source of innovation. What applicators expect is that the supplier's message provides some interesting point of contact. In other words, suppliers should offer information of high quality but not necessarily of high quantity. This can be observed in Case 3b and 5, where the supplier addresses future or distant needs of applicators and provides them a possibility to meet new marketplace opportunities.

In cooperative VCM, the innovative message is sent by the supplier and the manufacturer. Both actors convey information on the innovation's benefit and its technical feasibility. In contrast to non-cooperative VCM, applicators expect a "perfect message" if the supplier and the manufacturer cooperate. This is based on the argumentation that manufacturers are used to interact with applicators as it is their daily business. By cooperating, the supplier and the manufacturer can profit from a broader knowledge and must thus be able to transmit more detailed information on the innovation. In sum, applicators expect a higher level of knowledge overlap if they are confronted with cooperative VCM attempts.

Accordingly, the following hypothesis is presented:

Hypothesis 8: The positive impact of knowledge overlap on marketing effectiveness is higher in the case of cooperative than in the case of non-cooperative VCM attempts.

Figure 6.8 displays the adapted framework of this dissertation and summarizes the hypothesized relationships.

In order to test the research hypotheses, an agent-based model is proposed. It helps to remedy the deficiency of the case study research. While the case study highlights different observations regarding the marketing effectiveness of VCM, it lacks in external validity or generalizability (Eisenhardt 1989). It has to be noted that the case study sample is unbalanced, as there are three functionality-driven innovations, one process-driven innovation, and one really new product. Furthermore, the firms in the sample obviously do not represent all firms in their respective industries, and the selected projects clearly do not represent all VCM projects. Also, the process by which the VCM projects are selected may introduce some bias to the findings. In consequence, the case study research serves as an intermediate step to understand the VCM phenomenon. To empirically test the validity of the proposed patterns, a simulation study is described in Chap. 7. It permits the assessment of the

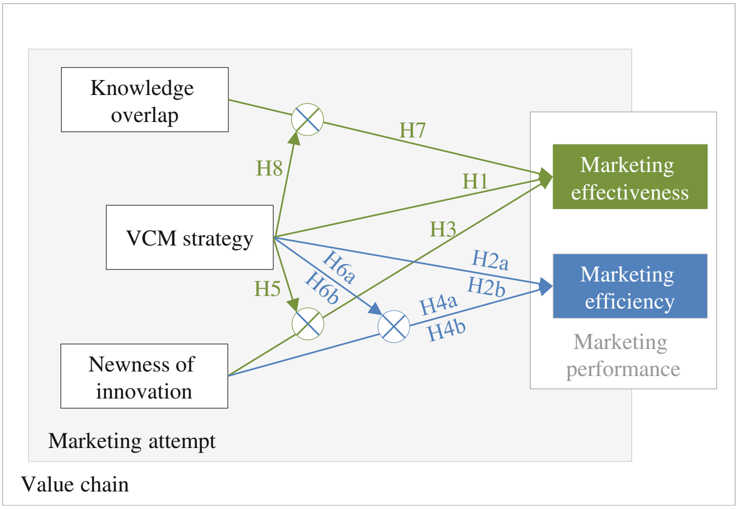


Fig. 6.8 Adapted framework and hypothesized relationships

effect of the critical factors for the supplier's marketing success in numerous settings. Moreover, it enables statistical analysis together with high reliability and facilitated replication.

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Part IV
Computational Modeling

Chapter 7
Agent-Based Simulation Study

With the help of an agent-based simulation study, the qualitative results of the case study should be supported. But the central aim of the simulation is to assist in identifying causal relationships that have previously gone unexplained, i.e. the interaction effects between the newness of supplier innovation and the VCM strategy as well as the knowledge overlap and the VCM strategy. Therefore, the goal is to answer the research questions (5)–(7): (5) How does the performance differ across the VCM strategies? (6) How do the identified factors influence the performance of a supplier's attempt to implement his present innovation? (7) How do these factors interact with respect to the performance?

In this chapter, a short introduction of ABM in marketing is given in Sect. 7.1. Next, the model of Ahrweiler, Gilbert and Pyka, labeled SKIN (**S**imulating **K**nowledge Dynamics in **I**nnovation **N**etworks) model, is presented as it is the inspiration of the VCM model developed in this study (see Sect. 7.2). Of course, not every problem in marketing can be effectively simulated using ABM. Accordingly, it is essential to assess if ABM is the right choice to simulate the VCM phenomenon (see Sect. 7.3). Thereafter, special attention is given to the description, calibration, implementation, as well as verification of the model in Sects. 7.4, 7.5 and 7.6. Next, the experimental design is described (see Sect. 7.7). A detailed analysis of the simulation results follows (see Sect. 7.8). This chapter ends with a discussion as well as an interpretation and validation of the simulation results (see Sect. 7.9).

7.1 Agent-Based Modeling in Marketing

To date, the opportunities of using agent-based modeling (ABM) in the field of marketing have been realized by some researchers, but a widespread acceptance and publication of this method cannot be observed. Recently, there has been practitioners interest in using agent-based modeling to explore marketing mix models, i.e. models that focus on the type of product, how it is promoted to

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customers, the method for distributing it to customers, and the amount the customers are willing to pay for it (see Garcia and Jager 2011; Rand and Rust 2011).

One existing ABM in the field of marketing mix models is the model of Garcia and Atkin (2005). Here, the aim is to gain insights into how coopetition strategies (through a coordinated marketing campaign) can affect the diffusion of wine bottles closure. Similar to the VCM model developed in this thesis, ABM is used to study the impact of micro-level firm strategies on global, macro-level effects, including adoption and diffusion of resistant innovations. To calibrate the model, Garcia and Atkin also incorporate real-data. Instead of case study data, they use a conjoint-analysis to model parameters, agent interactions, and agent decision rules. The simulation results show that a strategy of coopetition served as an instrument to diffuse the screw cap amongst resistant consumers (see also Garcia et al. 2007).

Another existing ABM in this field is a model to study the effectiveness of different promotional strategies (Delre et al. 2007). This model in particular concentrates on the targeting and timing of the promotions. It is used to simulate different promotional strategies to investigate the effects on product diffusion. From this learning, the best targeting and timing for launching innovative products can be identified. With respect to the VCM model, one important aspect is the timing of integrating the supplier's immediate customer in the VCM process (i.e. early vs. late integration). The results indicate that the issue of how and when to conduct promotional activities is highly important with respect to the diffusion dynamics of the product involved.

North et al. (2010), in turn, develop a model to study a multi-scale consumer market. This model simulates the interactions between consumers, retailers, and manufacturers of consumer packaged goods. The aim of this model is to see the development of a population as an effect of some marketplace changes, such as price reduction by one manufacturer or a new marketing campaign by a retailer. The output of this model can help firms in decision-making or in developing marketing strategies. This is also a central aim of the VCM model: develop a tool for suppliers to evaluate the performance of cooperative and non-cooperative VCM in advance.

As demonstrated by the previous examples, ABM is a powerful tool to simulate marketing elements because it allows researchers to include customer-level behavior models of richer fidelity that could be used to study the robustness of different marketing strategies (Rand and Rust 2011). This supports the statement of Sect. 4.2.3 that ABM is a suitable tool to model VCM and its processes. To date, there has been no such model before because VCM is an emerging phenomenon in the marketing literature.

7.2 Related Work: SKIN Model

Knowledge dynamics in innovation networks is also an issue that has been studied using ABM. There is one developed model to simulate the phenomenon in this area. The model is called SKIN. It describes the interactions in innovation networks that involve not only the trading of goods, but also the generation, exchange, and combination of knowledge (Ahrweiler et al. 2004). The process in the SKIN model shows similarities with the process of VCM. As in the VCM process, the SKIN model includes innovation marketing, acceptance of innovations, and interactions between different firms. It simulates the dynamics in knowledge-based market sectors, such as biotechnology or information communication technology.

In the SKIN model, the agents are heterogeneous and each of them is characterized by an individual knowledge base. This knowledge base is called its *kene* (Gilbert 1997) and contains a number of "units of knowledge" (Ahrweiler et al. 2004, p. 2). Each unit is defined as a combination of three components including an agent's capability (*C*) in a scientific, technological, or business domain (e.g. nanotechnology), its ability (*A*) to perform a certain application in this field (e.g. the usage of engineered nanofibers), and the expertise level (*E*) the agent has with respect to this ability. In other words, the expertise expresses the advancement of an actor's skills in the respective knowledge field. The three components are assigned with a random value of a certain range. The agent's knowledge base is its collection of *C*/*A*/*E*-triples (Ahrweiler et al. 2004).

Each agent in this model represents a firm that tries to innovate using its kene. To produce an innovation, a firm focuses on a subset of triples in its kene set called *innovation hypothesis*. It represents a potential innovation and describes the source an agent uses to be successful in the market (see Ahrweiler et al. 2004). Next, the innovation hypothesis is transformed into a product through a mapping procedure. This implies that the capabilities and abilities of the innovation hypothesis are used to calculate an index number that symbolizes the product. A product, in turn, is characterized by a certain quality. Instead of multiplying the capabilities and abilities for each triple, the abilities and the expertise levels of the innovation hypothesis are used to compute an index number that represents the quality. To get profit in the market, firms need to sell their innovations to other firms, i.e. customers, who need it. At the same time, each firm has to buy raw materials from another firm, i.e. supplier, to realize its innovations. What a firm needs is also determined by the innovation hypothesis (Ahrweiler et al. 2004).

Other than that, agents are able to improve their innovation performance through learning and cooperation. This is where the SKIN model uses the unique advantage of ABM, which allows agents to adapt. If a firm fails to sell its innovation, it should try to improve the innovation by conducting research. This process requires capital investment. But once a research is complete, the firm's kene set is improved. Moreover, an agent can decide to cooperate with another agent.

The SKIN model is a generic model that can be used to investigate different aspects of knowledge dynamics. This can be done by expanding the model with new rules or new features. Gilbert and his colleagues (2007) use the SKIN model to understand the effect of learning activities. They discover that a firm should acquire new capabilities from outside if it wants to improve its innovation. In another study, Ahrweiler et al. (2011) use the SKIN model to analyze the effect of having universities in the innovation network. They show that universities' existence improves the competence level of agents in general. Furthermore, Korber (2009) introduces new specifications or procedures to the SKIN model in order to study the impact of public fund on the innovative performance of agents.

The SKIN model is the inspiration of the VCM model. Several procedures presented in the SKIN model are used or modified to simulate VCM. The conceptual model that will be described in Sect. 7.4 serves as the generic model. Similar to the SKIN model, further development can always be made to investigate different aspects of VCM.

7.3 Appropriateness of ABM to Simulate VCM

A description of ABM has been presented and its advantages have been explained. Still, not every case can be effectively simulated using ABM. Thus, it is important to evaluate if ABM is the right approach to simulate VCM. The evaluation can be done using the appropriation described by Bonabeau (2002) and later by Rand and Rust (2011).

There are several aspects that are expected to exist in the problems under study. One of them is the temporal aspect, which means the focal problem involves changes of a complex system over time. This aspect exists in the VCM problem. The influencing factors of a value chain are changing over time. These factors include the knowledge of different agents, the expected value of innovation, and the customer needs. Therefore, the temporal aspect influences a supplier's decision in choosing the right marketing strategy. Hence, the VCM problem meets the first criterion.

It is also found that VCM shows several indicative characteristics, which increase the benefits of ABM (Rand and Rust 2011). The VCM problem involves a medium number of agents. According to Casti (1995), a medium number of agents expresses that though the system has a population of agents, this population can be influenced by a few important individual interactions. Therefore, the number of agents should not to be too small or too large. If the number is too small, the interactions are obvious and not interesting. If the number is too large, the population's behavior might not be affected by individual interactions anymore. Also, ABM becomes inefficient compared to statistical regression.

Other than that, the problem involves heterogeneous agents (Bonabeau 2002). There are three types of agents: suppliers, manufacturers, and end applicators. Not only different types of agents, but also agents from the same type have different characteristics which lead to different behaviors. For example, each supplier has different knowledge that is used to promote his innovation. Each manufacturer has different expectancy in deciding to support a supplier. Each applicator also has different expected values before accepting an innovation. Another important point is that the VCM problem requires agent's adaptation or ability to learn. A supplier, for instance, needs to improve his expertise in communication from time to time to be able to directly address an applicator. In another time, a supplier needs to refine his marketing strategy or to select another strategy when he fails to promote his innovation. ABM is one among very few approaches that enables adaptation or learning process. In summary, ABM is an appropriate modeling method to be used in simulating VCM. The conceptual model is described in the following section.

7.4 Model Description[1]

Motivated by the SKIN model, the VCM model includes three types of agents comprising suppliers, manufacturers, and applicators (see Ahrweiler et al. 2004; Gilbert et al. 2001). The agent-based model starts with the individual decision-making of a supplier. He tries to promote his present innovation (i.e. process-driven innovation, functionality-driven innovation, or really new product) via cooperative VCM, i.e. early integration of the manufacturer, or non-cooperative VCM, i.e. integrating the manufacturer at a later stage. Next, the supplier selects one manufacturer and/or applicator as target of his marketing attempt. The extent of knowledge the involved actors share varies and thus their knowledge overlap. The performance of a supplier's marketing attempt is measured in terms of the acceptance and implementation of an innovation as well as the marketing resources used. To study the impact of the VCM strategy, the newness of innovation, and the knowledge overlap systematically, an analysis of variance (ANOVA) is first conducted. It is useful in comparing three or more factors for statistical significance and shows R^2 that indicates the proportion of systematic variance explained by the identified factor effects to the unsystematic variance from all other factors in the simulation model (Field and Hole 2003). Second, the effect size of each significant factor effect is calculated.

The basic model is extended with a representation of knowledge dynamics in and between firms. In particular, the supplier attempts to increase his marketing performance by improving his knowledge base through adaptation to end applicators' needs and individual learning. As noted by Cyert and March (1963), firms learn from previous experience to adapt themselves to the conditions of the respective environment. The concept of experimental learning was first introduced by Dewey (1938) and initiates a discussion among researchers about learning-by-doing and learning-by-feedback (Michael 1973). Learning-by-doing describes the automatic process by which firms use their skills to become more practiced and more efficient at doing what they are already doing (Cohen and Levinthal 1989).

[1] Parts of this section are published (see Hintze and Lüthje 2014).

In turn, the feedback from the market and the customers (learning-by-feedback) helps firms to evaluate their success (Ahrweiler et al. 2011). More details are provided in Sect. 7.4.4 when presenting the process overview and scheduling.

In the next paragraphs, the elements and processes of the model are described in further detail.[2] The description of this conceptual model follows the protocol developed by Grimm et al. (2006, 2010). It is called ODD (**O**verview, **D**esign Concepts and **D**etails) for describing individual-based and agent-based models. This protocol is primarily introduced to simplify writing and reading model descriptions. It also supports modelers in defending their scientific work against criticism. To meet the big challenge of conveying the model details in a transparent manner, researchers choose the ODD protocol as it is the state-of-the-art tool. To calibrate the model in this study, the history-friendly approach is used (see Fagiolo et al. 2006). This approach implies that the case studies in the coatings and sealants industry presented in Chap. 6 are used to guide the modeling of parameters, agent interactions, and agent decision rules (see Garcia et al. 2007). As stated by Malerba et al. (2008, pp. 357–358), the aim is to "match overall patterns in qualitative features, particularly the trend behavior of the key descriptors of industry structure and performance".

7.4.1 Purpose

The first goal is to compare the performance of cooperative and non-cooperative VCM. The performance is measured based on the effectiveness and efficiency (Wagner 2010; Prahinski and Benton 2004). As stated in Sect. 6.7, effectiveness is represented by the rate of implemented innovations, whereas efficiency is related to money and time a supplier spends to perform his marketing attempt (Hoegl and Wagner 2005; Sheth and Sisodia 2002; Griffin 1997; Mentzer and Konrad 1991).

The second goal of the agent-based simulation is to systematically study the effect of the newness of innovation and the knowledge overlap through a relative comparison of the marketing performance of both VCM strategies.

7.4.2 Entities, State Variables, and Scales

In the VCM process, there are different actors or entities playing distinct roles.[3] These actors are represented as agents and are conceptualized as heterogeneous

[2] The VCM model presented here is uploaded to the OpenABM site (http://www.openabm.org/).

[3] According to Grimm et al. (2010, p. 7), an entity is "a distinct or separate object or actor that behaves as a unit and may interact with other entities or be affected by external environmental factors. Its current state is characterized by its state variables or attributes".

Table 7.1 Actors' state variables

Agent	State variable	Brief description
Supplier	Size → Capital	Size/capital of supplier firm
	Kene	Knowledge base of supplier firm
	Marketing concept	Marketing project of supplier firm
	Memory list(s)	List of memorized manufacturer firm(s)
		List of memorized applicator firm(s)
	Preference list(s)	List of preferred applicator firm(s)
		List of preferred manufacturer firm(s)
Manufacturer	Kene	Knowledge base of manufacturer firm
Applicator	Kene	Knowledge base of applicator firm
	Marketing concept	Marketing project of applicator firm
	Memory list(s)	List of memorized supplier firm(s)
		List of memorized manufacturer firm(s)

agents with respect to their perceptions, actions, and particular attributes. A total list of the actors' state variables is presented in Table 7.1.

Agents interact within a value chain. An agent uses its knowledge to interact according to its behavioral rules in order to reach its goal. The goal of the supplier is to promote and implement his innovation. To reach this goal, the supplier gets the ability to adapt his parameters of action over time. More details are provided in Sect. 7.4.4. The basic state variable of each value-chain agent is his kene set, which represents his knowledge base.[4]

7.4.2.1 Kenes

Each agent is specialized and starts the simulation with specific attribute values and with different knowledge bases. Here, the representation of the agents' knowledge base draws on the 'kene' concept developed by Ahrweiler et al. (2004). A kene consists of a vector containing different units of knowledge called triples. Each triple is characterized by three different elements: *K*, *A*, and *E*. In contrast to the SKIN model, the *K* in the VCM model describes the knowledge field. This represents an area in which a firm has specialized knowledge (e.g. chemical composition and transformation of materials). The second element, labeled *A*, refers to the amount of knowledge a firm has achieved in a specific knowledge field. The third element, labeled *E*, represents the expertise which reflects a firm's experience gathered in communicating its knowledge across the respective value

[4] Grimm et al. (2010, p. 7) define a state variable as "a variable that distinguishes an entity from other entities of the same type or category, or traces how the entity changes over time". Further, state variables should be "low level or elementary in the sense that they cannot be calculated from other state variables".

Fig. 7.1 A firm's kene set

$$\begin{bmatrix} K_0 \\ A_0 \\ E_0 \end{bmatrix} \begin{bmatrix} K_1 \\ A_1 \\ E_1 \end{bmatrix} \begin{bmatrix} K_2 \\ A_2 \\ E_2 \end{bmatrix} \cdots \begin{bmatrix} K_7 \\ A_7 \\ E_7 \end{bmatrix}$$

chain. This element has to be integrated to take the communication aspect of the VCM process into account.

In the VCM model, a firm's kene set consists of eight triples. A real firm might have more units of knowledge than eight triples. But a standard amount is applied to represent the small range of knowledge fields that are appropriate for specific innovations like innovations of material suppliers. Also, it shapes up as an adequate knowledge space size which reports stable results. The focus here is on the composition of a firm's knowledge set, thereby the assumption is made that all actors have the same size of their respective knowledge set (Conti and Hoisl 2012). Figure 7.1 visualizes the kene set of a firm. In the next paragraphs, a detailed specification of the different triple elements is provided.

Specification of the Knowledge Fields (K)

The first kene component, the knowledge fields, refers to the breadth of knowledge a firm has (Prabhu et al. 2005). Dosi et al. (2003) define organizational knowledge as the ability of an organization to perform its characteristic actions in order to develop products. These fields include the series of knowledge required to convert materials into final products (see Table 7.2). The *Ks* are sorted starting with those most related to suppliers placed in the upstream position of a value chain and ending with those most related to applicators placed in the downstream position of a value chain. An integer from 1 (i.e. knowledge field of suppliers) to 6 (i.e. knowledge field of applicators) is assigned to each *K* that will be used in the mapping or calculation throughout the model.

The selection of knowledge fields is based on pilot and case study interviews as well as papers that deal with the coatings and sealants industry. Accordingly, the fields are divided into three different categories: chemical (*K* 1 to 2), technical (*K* 3 to 4), and application-related knowledge fields (*K* 5 to 6). To comprehend this classification, the specific knowledge fields of the three types of agent are explained with the aid of Case 2 and Case 4 (see Sect. 6.6.1).

Case 2: UV absorber against broad-spectrum UV radiation in PET packaging

- Knowledge fields of the supplier:
  (1) *Chemical properties of substances and ingredients:*
  The supplier develops a new UV absorber that blocks board-spectrum UV radiation but allows visible light to pass through the package in order to maintain its transparency.

Table 7.2 Specification of the relevant agent's knowledge fields

K	Knowledge fields
1	Chemical properties of substances and ingredients
2	Chemical composition and transformation of materials
3	Formulation and testing of solutions
4	Converting and finishing of solutions
5	Functionality and aesthetics of final products
6	Market trends and regulations

(2) *Chemical composition and transformation of materials:*
The UV absorber is based on completely new photostable polyheterocyclic chromophores. In contrast to current absorbers, the new product offers broader UV protection while imparting less discoloration to the packaging material (Coughlin and Schambony 2008, p. 230).

- Knowledge fields of manufacturer:

(3) *Formulation and testing solutions:*
The new plastic additive (UV absorber) is incorporated into the polymer by dry blending following by compounding on a twin-screw extruder (Coughlin and Schambony 2008, p. 231).
(4) *Converting and finishing of solutions:*
Bottle pre-forms are prepared from the compounded PET pellets by injection molding. For the coating process, standard equipment and settings can be employed (Coughlin and Schambony 2008, p. 231).

- Knowledge fields of applicator:

(5) *Functionality and aesthetics of final product:*
The applicator expects a PET bottle that combines UV protection with an attractive packaging appearance. In this way, the end user can profit from a stable product quality, i.e. no changes in appearance, odor, and functionality of the cosmetic formula occur.

Case 4: PVC- and plasticizer-free sealant for metal Twist-off® closures

- Knowledge fields of the supplier:

(1) *Chemical properties of substances and ingredients*:
The supplier introduces a PVC- and plasticizer-free sealant compound that is characterized by good processability and pasturisability.
(2) *Chemical composition and transformation of materials*:
The PVC-free granulate lining compound is especially developed for the use in vacuum closures, lug caps, and Twist Off® closures. Different variants have been tailor made for the use in compression and injection lining technologies.

Table 7.3 Specification of the agent's amounts of within-field knowledge

A	Amounts of within-field knowledge
1	Small amount of within-field knowledge (basic knowledge)
2	Medium amount of within-field knowledge
3	High amount of within-field knowledge (deep knowledge)

- Knowledge fields of the manufacturer:
  (3) *Converting and finishing of solutions*:
  The manufacturer first liquefies the TPE granulates by using extrusion. Next, he equips metal closures with a washer instead of a full-surface compound. For the injection process, new equipment is required.
- Knowledge fields of applicator:
  (5) *Functionality and aesthetics of final product*:
  The applicator is looking for an inert solution that offers optimum and consistent opening and re-opening torques, safe vacuum retentions, as well as high performance for food safety. In this way, he is able to correspond to end user needs.
  (6) *Market trends and regulations:*
  With the help of the new PVC- and plasticizer-free sealant compound, applicators can meet the stringent migration limitations even for fatty or oily foodstuffs with longer shelf-lives.

Specification of the Amount of Within-Field Knowledge (A)

The second kene component, the amount of within-field knowledge, refers to the depth of understanding a firm has with regard to a specific knowledge field (Prabhu et al. 2005). It is described by qualitative degrees. Each level of knowledge amount is represented by an integer from 1 to 3 (see Table 7.3). Higher integer symbolizes a deeper understanding of a firm in a certain field. It represents a firm's core competence that is applied in many cases. An example: The business activities of the supplier in Case 3 are focused on the development and composition of resins, called polyurethanes and polycarbonates, used in tough chemical-resistant coatings, adhesives, and foams. Hence, the supplier has a deep understanding in the field "chemical composition and transformation of materials".

Specification of the Expertise Level (E)

The third kene element is the expertise level, which refers to the skill level that a firm has achieved from past experience in communicating its knowledge along the value chain. As mentioned before, it is integrated to consider the communication

Table 7.4 Specification of the agent's expertise levels in communication

E	Expertise levels
1	Low expertise level (lack of experience in communication)
2	Medium expertise level
3	High expertise level (high experience in communication)

aspect of the VCM process. Similar to the amount of within-field knowledge, the past experience is ordered into qualitative degrees (see Table 7.4). High degree of expertise implies that an actor has applied its knowledge in different marketing projects. A supplier, for instance, has talked to numerous applicators to explain the functionality of an innovation. Thus, he develops an appropriate communication strategy to reach applicators and persuade them.

7.4.2.2 Marketing Concept

Another variable of the agents is their marketing concept. It corresponds to the idea of the innovation hypothesis used in the *SKIN model* where firms apply their knowledge to create innovations (see Ahrweiler et al. 2011, 2004; Gilbert et al. 2001).

In the VCM model, the marketing concept represents a firm's strategy or philosophy to satisfy the needs of the target market. Therefore, it describes the source a firm uses for its attempts to make profits on the relevant market. An example: The supplier in Case 1 uses his knowledge to implement a functional barrier solution that keeps taste and aroma intact while protecting the packaged content from external impacts. This solution solves the big migration problem of food processing firms, i.e. the supplier's target group. Moreover, it helps to protect the health of consumers, i.e. the applicator's target group.

The marketing concept is built by two triples that are selected from a firm's kene set. These triples represent different business units or teams in a firm who are working together to address potential business partners. Each supplier and each applicator has his own marketing concept. Still, the idea of the marketing concept is slightly different for these two types of agents. From the supplier's perspective, the marketing concept (MC^S) describes the source he uses for his attempts to implement his innovation along the value chain. On the applicator's side, the marketing concept (MC^A) is the source he uses for his attempts to signalize his needs to direct and indirect suppliers in the value chain. More details are provided in Sect. 7.4.4.

7.4.2.3 Supplier Size and Marketing Capital

In the model, a supplier is active if he has an innovation and tries to implement it. In order to perform his marketing attempt, a supplier needs to have capital, which refers to the amount of budget that can be used for marketing. By contrast, the *SKIN* agents need capital to produce for the market and improve their knowledge base

(Ahrweiler et al. 2004). Like in reality, the specific amount of capital depends on the firm's size. In the model presented here, big supplier firms have twice as much capital as "normal" supplier firms. If a supplier firm runs out of capital, it cannot perform anymore marketing attempts.

7.4.3 Initialization

At the beginning of each simulation experiment, the first step is the initialization of the agents' kenes which is based on the pilot and case study results. As mentioned before, a kene represents a firm's knowledge base. In fact, it is possible that identical triples appear in a firm's kene. It shows the possibility of having more than one group in a firm which focuses on the same field of knowledge and has acquired the same amount of knowledge as well as expertise.

For every type of agent, specific rules are defined and different thresholds regarding the distribution of *K*s and *As* are developed. This is based on the fact that suppliers, manufacturers, and applicators play different roles due to their respective position in the value chain (see Fig. 7.2). As discussed in Sect. 3.3.3, suppliers have special know-how in chemical fields, manufacturers are experts in technical fields, and applicators specialize in product-related fields. In other words, every type of agent is characterized by a specific breadth of knowledge (*K*) and a specific depth of knowledge (*A*). They are more familiar with their own knowledge field than with surrounding fields. By contrast, the agent's expertise level (*E*) does not depend on its value-chain position. This implies that *Es* are distributed randomly without following any rules.

The initial distribution of the *supplier's kene elements* is based on the following facts: The knowledge fields 1 and 2 represent chemical fields and define a supplier's core competencies. Considering this fact, the first three of the eight kene triples are randomly distributed within the range of 1–2. These knowledge fields are highlighted in gray (see Fig. 7.3). In these fields, a higher *A* is allocated because

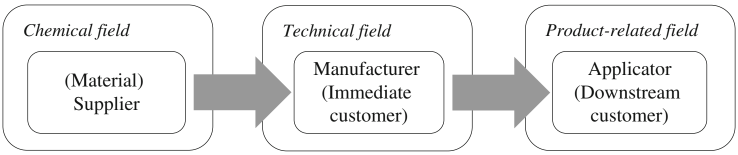


Fig. 7.2 Agents and their typical knowledge field

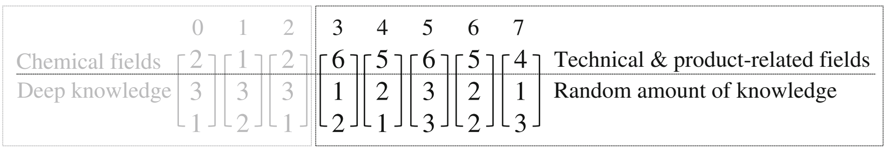


Fig. 7.3 Example of a supplier's kene set

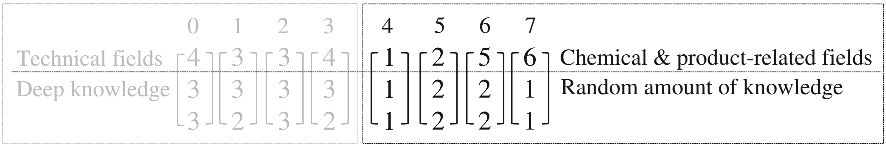


Fig. 7.4 Example of a manufacturer's kene set

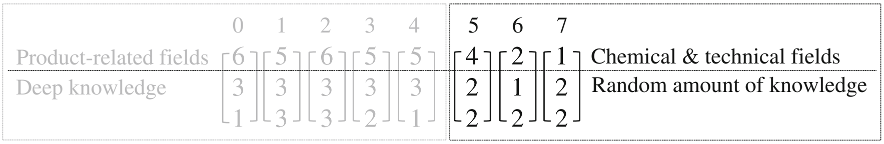


Fig. 7.5 Example of an applicator's kene set

of a supplier's deep understanding. But suppliers heavily depend on derived demand and need to have knowledge in other fields (i.e. technical and product-related fields) to interact with immediate and downstream customers. If a supplier focuses on the communication with downstream customers, three of the eight kene triples are randomly distributed within the range of 5–6 (i.e. product-related fields). If he centers his efforts on the manufacturer, three of the eight kene triples are randomly distributed within the range of 3–4 (i.e. technical fields). The last two of the eight kene triples are randomly distributed within the range of 4–6. In the fields 3–6, the amount of within-field knowledge is randomly distributed within the range of 1–3 because suppliers are not necessarily experts in these knowledge fields.

The *manufacturer* specializes in the fields 3 and 4 (i.e. technical fields). This implies that four of the eight kenes triples are randomly distributed within the range of 3–4 (see Fig. 7.4). In these fields, the triples are characterized by a high amount of within-field knowledge because of a manufacturer's deep understanding. Due to his position in the value chain, the manufacturer needs to know the business of the supplier and the end applicator to negotiate with both parties. Accordingly, two of the eight kene triples are randomly distributed within the range of 1–2 (i.e. chemical fields) and the other two within the range of 5–6 (product-related fields). In the knowledge fields 1–2 or 5–6, the amount of within-field knowledge is randomly distributed within the range of 1–3 because manufacturers are not necessarily experts in these knowledge fields.

The knowledge fields 5 and 6 (i.e. product-related fields) represent the core competencies of an *applicator*. Five of his eight kene triples are thus distributed within the range of 5–6 (see Fig. 7.5). In these fields, a higher *A* is allocated because of an applicator's deep understanding. In fact, the applicator is the most powerful actor in the value chain and does not depend on either the supplier or the manufacturer. Still, he is highly interested in innovations. To interact with upstream players, he needs to have knowledge in other fields (i.e. chemical and technical fields). This implies that three of the eight kene triples are randomly distributed within the range of 1–4. In these fields, the amount of within-field knowledge is

Table 7.5 Initial distribution of agent's kene elements

Agent	Kene triple's element	Distribution
Supplier	K	Three of the kene triples are randomly distributed within the range of 1–2.
		Three of the kene triples are randomly distributed within the range of 3–6. – If the first of these three Ks is within the range of 3–4, all of these three triples are within the range of 3–4. – If the first of these three Ks is within the range of 5–6, all of these three triples are within the range of 5–6.
		Two of the kene triples are randomly distributed within the range of 4–6.
	A	For the triples with a K from 1–2, the A of those triples is 3.
		For the triples with a K from 3–6, the A is randomly distributed within the range of 1–3.
Manufacturer	K	Four of the kene triples are randomly distributed within the range of 3–4.
		Two of the kene triples are randomly distributed within the range of 1–2.
		Two of the kene triples are randomly distributed within the range of 5–6.
	A	For the triples with a K from 3–4, the A of those triples is 3.
		For the triples with a K from 1–2 or 5–6, the A is randomly distributed within the range of 1–3.
Applicator	K	Five of the kene triples are randomly distributed within the range of 5–6.
		Three of the kene triples are randomly distributed within the range of 1–4.
	A	For the triples with a K from 5–6, the A of those triples is 3.
		For the triples with a K from 1–4, the A is randomly distributed within the range of 1–3.

randomly distributed within the range of 1–3 because applicators are not necessarily experts in these knowledge fields.

The initialization rules of the supplier, the manufacturer, and the applicator are summarized in Table 7.5.

During the initialization, the agents' marketing concepts are built from their kene sets. As mentioned before, a marketing concept describes a firm's strategy to fulfill customer needs. The goal of the supplier is to satisfy the needs of his immediate and downstream customers. Thus, his marketing concept (MC^S) is composed by two triples that provides technical (*K* 3 or 4) and/or product-related improvements (*K* 5 or 6). In other words, *K* is higher than or equal to 3.

In addition, the two triples represent *Ks* which occur most often. This rule is based on the understanding that a firm builds its marketing concept based on the knowledge fields it has focused on. These fields are highly relevant in the value

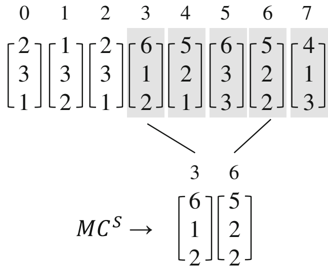


Fig. 7.6 Selection process of a supplier's marketing concept

chain in which a firm operates. Figure 7.6 visualizes the formulation of a supplier's marketing concept. In the presented kene set, it can be seen that triple-3 to -7 (highlighted in gray) are the triples with *Ks* higher than or equal to 3. These are the triples that are qualified to be selected into the supplier's marketing concept because they can provide a new product with enhanced productivity, resource efficiency, and product functionality. In the example, *K* 5 and 6 are the fields which occur more than once. These fields have main importance in the respective value chain. In building a marketing concept, one of the triples with *K* 5 and one with *K* 6 are selected randomly. Here, triple-3 and -6 are selected and represent the supplier's marketing concept.

Newness of Innovation and Knowledge Overlap

The field of knowledge (*K*), the amount of knowledge (*A*), the expertise in communication (*E*), and the marketing concept (*MC*) are the basic variables of the agents. Additionally, there are two derivative variables: newness of innovation and knowledge overlap between the involved value-chain actors.

Newness of Innovation

In the VCM model, the newness or type of innovation is derived using the two *Ks* that are available in the supplier's marketing concept. As mentioned, the main goal of the supplier is to satisfy expressed or future needs of customers, especially downstream customers.

If both *Ks* range from 3 to 4, the supplier focuses on technical fields and offers a *process-driven innovation*. In Case 5, the supplier offers such an innovation. It is a ready to use compound that reforms the production process by eliminating both core competencies of the manufacturer, the formulation (*K* 3) and the finishing step (*K* 4). This one component concept or one step process allows easy recycling, lower production costs, and enhanced productivity to OEMs by applying a polymerization reactor technology.

If both *Ks* are within 5–6, the supplier focuses on product-related fields and tries to implement a *functionality-driven innovation*. This situation can be observed,

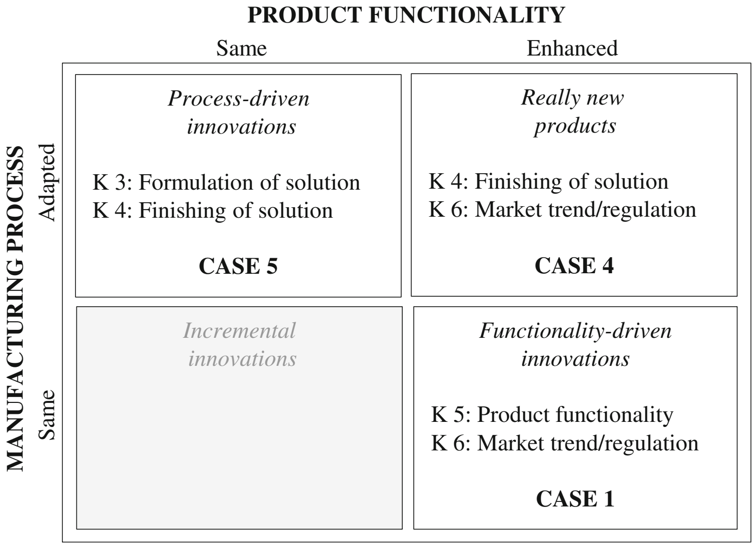


Fig. 7.7 Newness of innovation in the VCM model

inter alia, in Case 1. Here, the supplier provides an inert solution to prevent mineral oil residues from migrating from cardboard packaging into food within the shelf-life of the packaged good. Thus, the supplier innovation corresponds to market trends and regulations (*K* 6). Moreover, the barrier solution improves the product functionality by keeping taste and aroma intact (*K* 5).

If one of the *Ks* is within 3–4 and the other *K* is within 5–6, the supplier offers a *really new product*. In Case 4, the supplier provides such a product. It is a PVC- and plasticizer-free sealant for metal Twist-off® closures that meets the stringent migration limitations even for oily foodstuffs with longer shelf-lives and ensures compliance with the legal requirements (*K* 6). But the closures are equipped with a washer. Consequently, the development of new machinery is required to inject a washer and not a full-surface compound (*K* 4). The ideas of the last paragraphs are summarized in Fig. 7.7.

Due to complexity, the representation of the supplier innovation is restricted to two triples which describe the two most distinctive characteristics. In reality, supplier innovations can be characterized by more than two features.

Knowledge Overlap

Regarding the knowledge overlap, the knowledge similarity of two firms is measured. This value is derived from the *Ks* in a firm's kene set. It equals the number of common *Ks* that belong to the two firms of interest (cf. Conti and Hoisl 2012). In the case of non-cooperative VCM attempts, the knowledge fields of the supplier and that of the applicator are compared. If the supplier decides to integrate the

Table 7.6 Examples of degrees of knowledge overlap

Knowledge overlap	Example cooperative VCM		Example non-cooperative VCM	
Small (1 common field)	List of Ks Supplier + Manuf.:	[1] [2] [ ] [4] [ ] [6]	List of Ks Supplier:	[1] [2] [ ] [4] [ ] [6]
	List of Ks Applicator:	[ ] [ ] [3] [ ] [5] [6]	List of Ks Applicator:	[ ] [ ] [3] [ ] [5] [6]
	Common field:	[ ] [ ] [ ] [ ] [ ] [6]	*Common field*:	[ ] [ ] [ ] [ ] [ ] [6]
Medium (2–3 common fields)	List of Ks Supplier + Manuf.:	[1] [2] [3] [4] [5] [6]	List of Ks Supplier:	[1] [2] [3] [ ] [5] [6]
	List of Ks Applicator:	[ ] [ ] [3] [ ] [5] [6]	List of Ks Applicator:	[ ] [ ] [3] [ ] [5] [6]
	Common fields:	[ ] [ ] [3] [ ] [5] [6]	*Common fields*:	[ ] [ ] [3] [ ] [5] [6]
High (4–5 common fields)	List of Ks Supplier + Manuf.:	[1] [2] [3] [4] [5] [6]	List of Ks Supplier:	[1] [2] [ ] [4] [5] [6]
	List of Ks Applicator:	[1] [2] [ ] [4] [5] [6]	List of Ks Applicator:	[1] [2] [ ] [4] [5] [6]
	Common fields:	[1] [2] [ ] [4] [5] [6]	*Common fields*:	[1] [2] [ ] [4] [5] [6]

manufacturer, the knowledge fields of the supplier and the manufacturer are summed and then compared to the knowledge fields of the applicator. This is based on the fact that the manufacturer supports the supplier's marketing attempt to implement a present innovation. The manufacturer is able to improve the supplier's kene set. He has much experience in interacting with downstream customers as it is his daily business.

As shown by Cowan and Jonard (2009), the size of the knowledge overlap is a determining factor in innovation success. In the VCM model, a small overlap exists if the involved actors have one field in common. If they share 2–3 fields, the overlap is of medium size. A high overlap exists if the actors have 4–5 common fields. Examples for the different degrees of knowledge overlap are presented in Table 7.6.

7.4.4 Process Overview and Scheduling

After the initialization, all agents are created and ready to play their roles. The VCM process is started by suppliers. A single process ends if there is an implementation or a rejection of the innovation. If an innovation is rejected, the supplier tries to improve his marketing concept and starts a new marketing attempt. If possible, he searches through the qualified triples ($K \geq 3$) and selects a triple with a higher A.

An example is shown in Fig. 7.8. In the first step, the supplier selects triple-3 and -6 in his marketing concept (highlighted in light gray). Triple-3 is characterized by

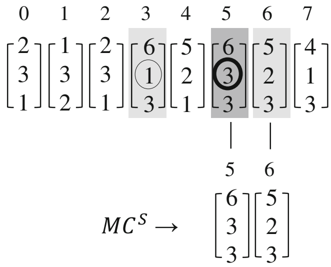


Fig. 7.8 Improvement process of a supplier's marketing concept

a low *A* (1). To be successful in the second step, the supplier searches for a triple with the same *K* (6) but a higher *A* (2 or 3). These conditions are fulfilled in triple-5 (highlighted in dark gray). As a result, the new marketing concept of the supplier consists of triple-5 and -6.

Furthermore, *E* of triple-3 and triple-6 has increased by one because these triples have been used in the initial marketing concept and the supplier has obtained learning experience. He gets some feedback from (potential) customers.

This improvement step is comparable with the incremental research in the *SKIN model* where a firm tries to improve its product. To perform incremental research, a firm changes one of its abilities chosen from the triples in its innovation hypothesis but keeps at its key capabilities in general (Ahrweiler et al. 2004). Compared to the VCM model, the expertise levels of the triples used in the innovation hypothesis are increased by one and the expertise levels of the other triples are decremented by one. In this way, learning-by-doing is modeled in the SKIN model (Ahrweiler et al. 2004).

The users of the VCM model are given the options to run the process using cooperative and non-cooperative VCM. These two processes are separated to enable a comparison of their effectiveness and efficiency. The process of each strategy is described as follows.

7.4.4.1 Non-cooperative VCM

The process of non-cooperative VCM starts with the supplier selecting one end applicator randomly as a target of his marketing attempt. A single non-cooperative VCM process by a single supplier is visualized in a flow chart and is illustrated in Fig. 7.9. In this figure, the critical hurdles or thresholds are highlighted in gray. The first threshold refers to the match of objectives and the second, more critical one, describes the value judgment.

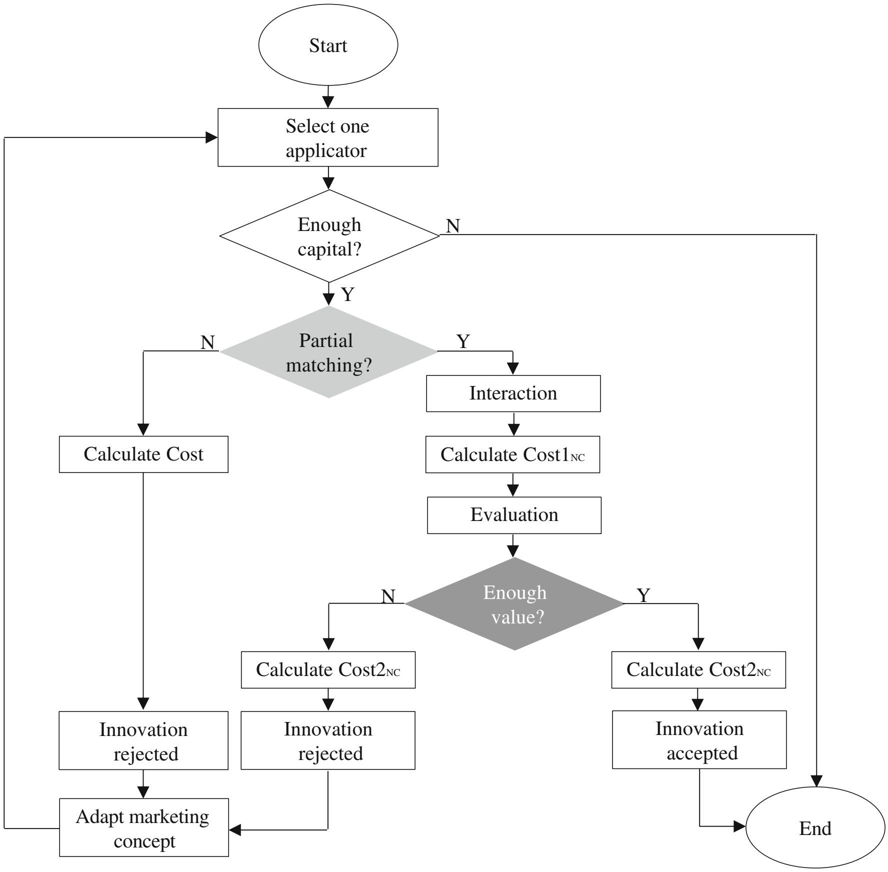
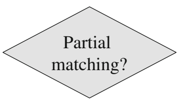


Fig. 7.9 Non-cooperative VCM process

Evaluation of the Marketing Objectives



As stated by Rogers and Shoemaker (1971), the innovation-decision process describes a mental process through which an individual passes. It first starts with knowledge of an innovation, followed by a decision on whether to adopt or reject it, and ends with a confirmation of the decision made. With respect to the model, the supplier first addresses an applicator to present his innovation and to create awareness for the new idea. The decision of the applicator to invite the supplier to gain further knowledge about the innovation depends on the comparison of the supplier's marketing objectives and his own objectives. As depicted in Eq. (7.1), the

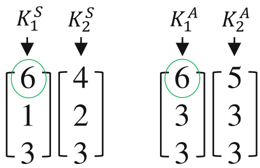


Fig. 7.10 Example of a partial match of marketing objectives

applicator compares the knowledge fields (*Ks*) used in the supplier's marketing concept (MC^S) with his own *Ks* used in his marketing concept (MC^A).

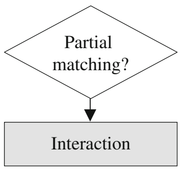
$$Invitation: \begin{cases} yes,\ if\ K_1^S = K_1^A\ or\ K_1^S = K_2^A\ or\ K_2^S = K_1^A\ or\ K_2^S = K_2^A \\ no,\ if\ K_1^A \neq K_1^A\ or\ K_1^S \neq K_2^A\ or\ K_2^S \neq K_1^A\ or\ K_2^S \neq K_2^A \end{cases} \tag{7.1}$$

As discussed in Sect. 3.3.2, the applicator is open to supplier innovations. He does not expect a perfect match as he is interested in new ideas to solve existing and future problems as well as differentiate himself from competitors. Actually, applicators perceive suppliers as an important and attractive source of innovation. This implies that if at least one of the *Ks* is present in both marketing concepts, the applicator develops an interest and invites the supplier. To summarize, the supplier and the applicator must have at least one same first item on the marketing agenda (Fig. 7.10).

If there is no partial match, the supplier information is not relevant to the applicator. Thus, the applicator rejects the supplier innovation. Next, the supplier tries to adapt his marketing concept by replacing one of the selected triples and by drawing another triple with a higher *A* (see Fig. 7.8). In addition, the *Es* of the used triples increase by one as the supplier learn about the audience to transmit more relevant information.

The described procedure is related to the partner search procedure in the *SKIN model* where users of the model can choose between a conservative and a progressive strategy (Ahrweiler et al. 2004). In both strategies, a firm's capabilities in its innovation hypothesis are compared with the capabilities of a possible partner as seen in its advertisement. If a firm adopts a conservative strategy, it looks for a partner with similar capabilities. In contrast, if a firm uses a progressive strategy, it is interested in different capability sets.

Interaction Process



After comparing the marketing objectives, the interaction process between a supplier and an applicator starts. Both create a marketing message and transmit it to the other party. To create a message, the agents use their marketing concept. As mentioned before, MC^S describes the source the supplier uses for his attempt to implement his present innovation. Developing this marketing concept into a message (M) is a mapping procedure where the *Ks* and the *As* of the marketing concept are used to compute an index number that represents the supplier's message [see Eq. (7.2)].

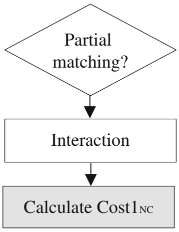
$$M = \sum_{i \in MC^s} (K_i \times A_i) \tag{7.2}$$

On the other side, the marketing concept of the applicator (MC^A) describes the source he uses to signalize his needs and requirements to the supplier. This concept is applied to generate the expected message (*EM*) of the applicator that is described by

$$EM = \sum_{i \in MC^A} (K_i \times A_i) \tag{7.3}$$

This procedure is also based on the *SKIN model* where the capabilities and abilities of the innovation hypothesis are used to calculate an index number that defines the product (Ahrweiler et al. 2004, p. 3).

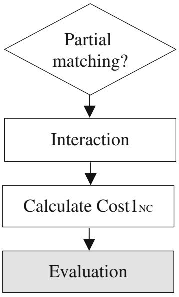
Calculation of the Non-cooperative Marketing Cost 1 ($Cost1_{NC}$)



In non-cooperative VCM, the first cost that a supplier spends is the cost to address an end applicator in order to transmit his marketing message. If the supplier tries to match *M* to *EM*, there is communication going on. Two parties could effectively communicate if they share common knowledge (cf. Sect. 3.3.3). In this case, the supplier could transmit his message to the end applicator easier. If *M* and *EM* are totally different, the supplier would need to spend more efforts to interact. Based on this argumentation, the first cost factor in non-cooperative VCM is proportional to the difference of *M* and *EM* as depicted in Eq. (7.4). The equation is scaled using a constant ($C1_{NC}$) to enable a comparison with other cost factors. More details on the cost calculation can be found in Appendix C1.

$$Cost1_{NC} = (C1_{NC} \times |M - EM|) \tag{7.4}$$

Evaluation Process



After the interaction process, the applicator attempts to judge the value the supplier innovation offers. The value as perceived by the applicator depends on the supplier's marketing performance. The applicator could sense the value of the innovation only if the supplier has a deep understanding regarding certain fields of knowledge and if the supplier is also able to transmit this understanding appropriately to the applicator. Using this argumentation, the customer value as perceived by the applicator is a function of K, A, and E. As stated by Woodruff (1997), the customer value refers to a customer's perceived preference for and assessment of innovation attributes, performances, and consequences.

In the model presented here, the customer value offered by the supplier is derived from his marketing concept (MC^S). This offered value describes the value the supplier innovation offers to the applicator, e.g. a barrier solution for cardboard packaging like in Case 1. This value is proportional to his fields of knowledge (K_j) and his expertise E_j. It can only be created with at least an average amount of knowledge ($A_j \in \{2,3\}$) [see Eqs. (7.5), (7.6), and (7.7)]. A low amount of knowledge ($A_j \in \{1\}$) does not contribute to the customer value because it refers to a missing competence of the supplier to speak on a subject (see Levitt 1965).

$$CV_{NC} = \sum_{j \in MC^S} (cv_j) \tag{7.5}$$

where

$$cv_j = K_j \times E_j \quad \text{if} \quad A_j \in \{2,3\} \quad j \in MC^S \tag{7.6}$$

$$cv_j = 0 \qquad \text{if} \quad A_j \in \{1\} \quad j \in MC^S \tag{7.7}$$

Besides the customer value offered by the supplier, the applicator also has a certain expected or desired value (ECV_{NC}). This expected value is what the applicator looks for in order to achieve his main goal, e.g. protect the health of consumers like in Case 1 (Flint et al. 1997). In the VCM model, the expected customer value is derived from the applicator's marketing concept (MC^A). It is proportional to his fields of knowledge (K_j) and his expertise (E_j). The calculation is similar to the one of the customer value offered by the supplier (CV_{NC}) [see Eqs. (7.8), (7.9), and (7.10)].

$$ECV_{NC} = \sum_{j \in MC^A} \left(ecv_j \right) \tag{7.8}$$

where

$$ecv_j = K_j \times E_j \text{ if } A_j \in \{2, 3\} \quad j \in MC^A \tag{7.9}$$

$$ecv_j = 0 \qquad \text{if } A_j \in \{1\} \quad j \in MC^A \tag{7.10}$$

The described calculation of the customer value is based on the model of Korber and Paier (2011). They create a mechanism of evaluating the scientific and technological value of R&D concepts instead of marketing concepts.

At this point, it has to be noted that the modeler tries to eliminate a systematic discrimination of really new products from the very beginning. The case study results show that final applicators mainly ask for functionality-driven innovations to correspond to end user needs and trends. As this type of innovation is regularly in demand, it can be implemented more easily. Sometimes, a new functionality can only be achieved in combination with a new process. In these projects, applicators also ask for really new products (RNPs). Besides details about the product functionality, they expect valuable information describing the new process technology. If the supplier can offer this kind of information, the process element of the supplier innovation is not a critical innovation attribute. A prerequisite is, however, that the supplier has a deep understanding ($A_j \in \{3\}$) in the relevant technical knowledge fields ($K3$ or $K4$). If the supplier is able to fulfill this condition, the process attribute of a really new product (RNP) is just as valuable as a product or user attribute ($K5$ or $K6$). Figure 7.11 visualizes the idea how to eliminate a systematic discrimination of really new products (RNPs). The visualization is based on Case 4.

As a reminder, the supplier in Case 4 provides a PVC- and plasticizer-free sealant for metal closures that meets the stringent migration limitations even for oily foodstuffs with longer shelf-lives and ensures compliance with the legal requirements (K 6). But the closures are equipped with a washer. In consequence, the development of new machinery is required to inject a washer and not a full-surface compound (K 4). To offer the required information about the process technology (K 4), the supplier cooperates with a manufacturer. In this way, the supplier is able to fulfill the condition $A_j \in \{3\}$. The calculation of the customer value offered by the supplier innovation is shown in Fig. 7.11.

Fig. 7.11 Elimination of a systematic discrimination of RNPs

Case 4: PVC- and plasticizer-free sealant for metal closures
Calculation of the value offered by RNP:

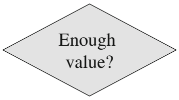
$$\begin{matrix} K \\ A \\ E \end{matrix} \begin{bmatrix} 6 \\ 2 \\ 3 \end{bmatrix} \begin{bmatrix} \mathbf{4} \\ \mathbf{3} \\ 2 \end{bmatrix} \quad \begin{aligned} CV &= (K_1^S \times E_1^S) + (K_2^S \times E_2^S) \\ CV &= (6 \times 3) + (4 \times 2) \\ \boldsymbol{CV} &= \mathbf{26} \end{aligned}$$

$A_j \in \{3\})$ ✓

Calculation of the value offered by RNP after eliminating the systematic discrimination of RNP:

$$\begin{matrix} K \\ A \\ E \end{matrix} \begin{bmatrix} 6 \\ 2 \\ 3 \end{bmatrix} \begin{bmatrix} \mathbf{6} \\ \mathbf{3} \\ 2 \end{bmatrix} \quad \begin{aligned} CV &= (K_1^S \times E_1^S) + (K_2^S \times E_2^S) \\ CV &= (6 \times 3) + (6 \times 2) \\ \boldsymbol{CV} &= \mathbf{30} \end{aligned}$$

Comparison of the Offered and the Expected Customer Value

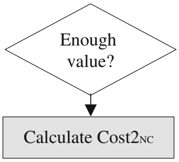


At this stage, the applicator wants to know if the value offered by the supplier meets his expected or desired value. In the VCM model, the applicator compares CV_{NC} and ECV_{NC} to make his decision to accept or reject the innovation as formulated in Eq. (7.11). This decision is highly critical in non-cooperative VCM attempts. The applicator accepts the supplier innovation if the value offered by the supplier corresponds or exceeds his expected value. In this case, the applicator gains a favorable attitude toward the supplier innovation. Otherwise, the supplier innovation is rejected.

$$Acceptance : \begin{cases} yes, \ if \ CV_{NC} \geq \ ECV_{NC} \\ no, \ if \ CV_{NC} < \ ECV_{NC} \end{cases} \tag{7.11}$$

Despite any rejection, the supplier has gone through a full VCM process at this stage. He has interacted with an applicator and has gained some learning (learning-by-doing, see Sect. 7.4.4). Actually, the supplier becomes more practiced and more efficient at doing what he is already doing (see Cohen and Levinthal 1989). Therefore, he has improved his knowledge base and this shall be reflected in his kene set. The amount of within-field knowledge and the expertise of the supplier are increased by one for the triples that have been used in the marketing concept. This, however, can only happen if there is still room for improvement, i.e. A and E are lower than 3.

Calculation of the Non-cooperative Marketing Cost 2 ($Cost2_{NC}$)



In non-cooperative VCM, the second cost that a supplier spends is the cost to explain and demonstrate the value of his present innovation. This cost element depends on the supplier's marketing performance. Once again, the applicator could evaluate the innovation attributes only if the supplier has a deep knowledge in the relevant fields and if the supplier is able to transmit this knowledge appropriately to the applicator. In the case of supplier's inability, the value offered by the supplier will diverge widely from the value expected by the applicator. Consequently, the interaction process between the supplier and the end applicator is characterized by communication problems and thus high costs.

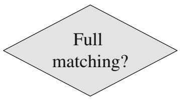
Based on this argumentation the second cost factor in non-cooperative VCM is proportional to the difference of CV_{NC} and ECV_{NC} as depicted in Eq. (7.12). It implies that the bigger the difference between the offered and the expected value, the higher the cost the supplier needs to spend in order to convince the applicator. The equation is scaled using a constant ($C2_{NC}$) to enable a comparison to other cost factors. More details on the cost calculation can be found in Appendix C1.

$$Cost2_C = (C2_C \times |CV_C - EV_C|) \tag{7.12}$$

7.4.4.2 Cooperative VCM

After having an overview of the non-cooperative VCM process, the different steps of the cooperative VCM process should be described. The special characteristic of this strategy is that the manufacturer is integrated at the early beginning of the VCM process. Therefore, the supplier first selects one manufacturer randomly. The single process of cooperative VCM by a single supplier is shown in Fig. 7.12. The critical hurdles or thresholds are highlighted in gray. In contrast to non-cooperative VCM, the first threshold is more critical than the second one. The different steps of the process are described as follows.

Evaluation of the Marketing Objectives



At first, the supplier approaches a manufacturer to ask for support to implement his innovation. By early integration of the manufacturer, the supplier could take advantage of the manufacturer's knowledge. But the decision of the manufacturer

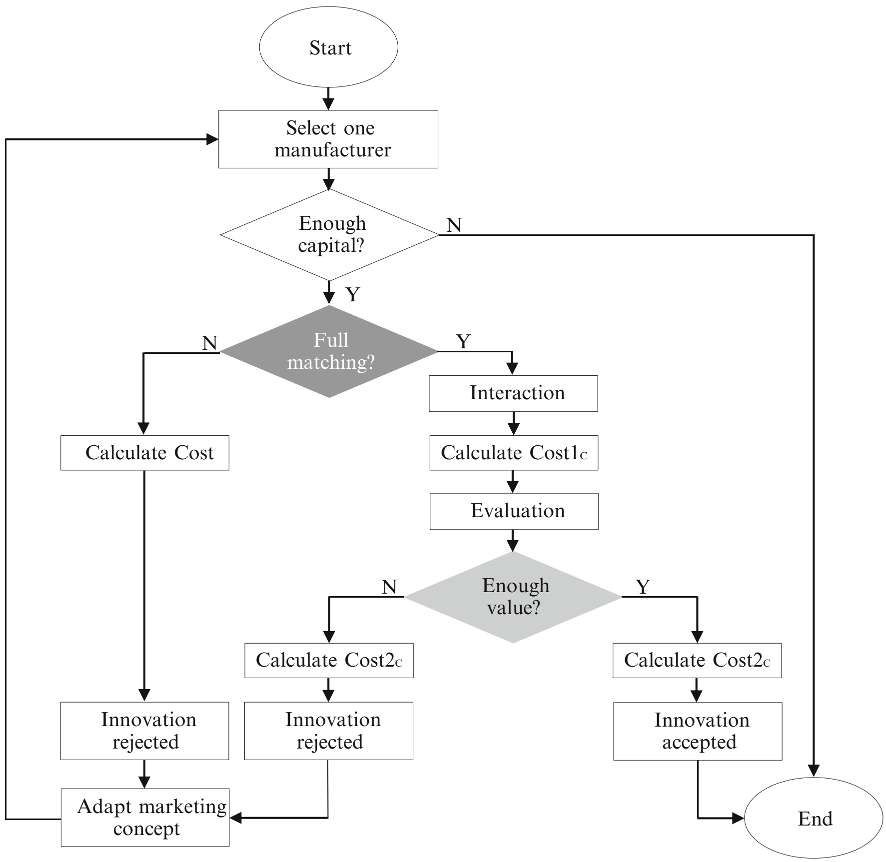


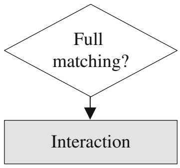
Fig. 7.12 Cooperative VCM process

to support the supplier's marketing attempt depends on his comparison of the objectives of the supplier and that of the applicator. Due to his position in the value chain, the manufacturer is well-informed on the present objectives of the supplier and the applicator. He only supports a supplier's marketing attempt if both knowledge fields (K_s) used in the supplier's marketing concept (MC^S) also occur in the applicator's concept (MC^A) [see Eq. (7.13)]. In other words, the manufacturer expects a perfect match.

$$Support: \begin{cases} yes,\ if\ K_1^S = K_1^A\ and\ K_2^S = K_2^A\ \ or\ K_1^S = K_2^A\ \ and\ K_2^S = K_1^A \\ no,\ if\ \ K_1^S \neq K_1^A\ and\ K_2^S \neq K_2^A\ \ or\ K_1^S \neq K_2^A\ \ and\ K_2^S \neq K_1^A \end{cases} \quad (7.13)$$

As described earlier, the manufacturer is characterized by an antagonistic attitude toward supplier innovations. He expects that the focal supplier innovation fully corresponds to the relevant applicator's needs. This implies that the applicator must require the innovation offered by the supplier. Only in this case, the manufacturer is willing to support the supplier's marketing attempt to not place the business relationship with the applicator at risk. But this threshold is hard to fulfill. If the applicator has one or two other items on his marketing agenda, the manufacturer rejects the innovation. In this case, the manufacturer does not feel impelled to cooperate. In other words, the need uncertainty is too high. Consequently, the supplier has to start a new marketing attempt.

Interaction Process



After comparing the marketing objectives, the interaction process between the supplier, the manufacturer, and the applicator starts. First, the supplier and the manufacturer create a joint marketing message. To create this message, the supplier uses his marketing concept and the manufacturer tries to improve it (MC^{SM}) by replacing one or two of the supplier's triples with triples of his own kene set that have the same K with a higher A (highlighted in gray). This implies that the manufacturer uses his knowledge base to reduce the present distance between the supplier and the applicator.

An example is visualized in Fig. 7.13. In the last triple of his kene set, the manufacturer has a deeper understanding in the knowledge field 6. Therefore, the first triple of the supplier's marketing concept (MC^{S}) is replaced and the last triple of the manufacturer's kene set is added to the joint marketing concept (MC^{SM}).

In the VCM model, the joint marketing concept then describes the source the supplier and the manufacturer use for their marketing attempt to jointly implement the innovation. Developing this concept into a joint message (*joint M*) is a mapping procedure where the *Ks* and the *As*of the joint marketing concept are used to compute an index number that represents the joint message [see Eq. (7.14)].

$$joint\ M = \sum_{i \in MC^{SM}} (K_i \times A_i) \tag{7.14}$$

As in the case of non-cooperative VCM, the marketing concept of the applicator is also used to generate his expected message [cf. Eq. (7.3)].

In the *SKIN model*, this procedure is described as learning from partners to exploit external knowledge sources (Ahrweiler et al. 2011, 2004). If the partner possesses a similar triple with respect to capability and ability but has a higher expertise level the firm will replace its own triple and add the partner's one (Ahrweiler et al. 2004, p. 6).

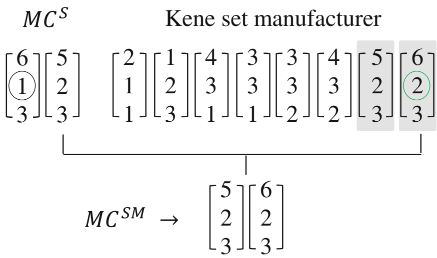
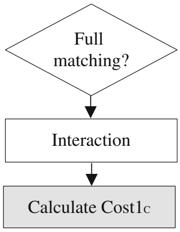


Fig. 7.13 Joint marketing concept

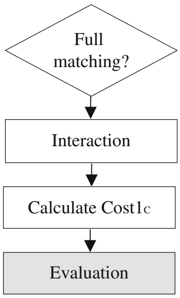
Calculation of the Cooperative Marketing Cost 1 ($Cost1_c$)



Similar to non-cooperative VCM, the first cost element that the supplier spends is the cost to address an applicator. The supplier cooperates with a manufacturer in order to transmit a joint message. The first cost factor in cooperative VCM is proportional to the difference of *joint M* and *EM* as depicted in Eq. (7.15). The equation is scaled using a constant ($C1_C$) to enable a comparison to other cost factors. More details on the cost calculation can be found in Appendix C1.

$$Cost1_c = (C1_C \times |joint\ M - EM|) \tag{7.15}$$

Evaluation Process



As in non-cooperative VCM, the value of the innovation needs to be evaluated. However, the joint marketing concept (MC^{SM})) is used to describe the innovation to the applicator. As the manufacturer supports the supplier, the value as perceived by the applicator is contributed by both the supplier and the manufacturer as shown in Eqs. (7.16), (7.17), and (7.18). An example was presented in Case 4 where the supplier and the manufacturer describe a PVC- and plasticizer-free sealant for metal closures. The value of the innovation is proportional to the knowledge fields (K_j) and the expertise (E_j) used in the joint marketing concept (MC^{SM}). The limitation still holds: the amount of knowledge must be at least two ($A_j \in \{2,3\}$) so that the applicator could sense the value of the innovation.

$$CV_C = \sum_{j \in MC^{SM}} \left(cv_j\right) \tag{7.16}$$

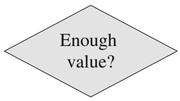
where

$$cv_j = K_j \times E_j \quad \text{if} \quad A_j \in \{2,3\} \quad j \in MC^{SM} \tag{7.17}$$

$$cv_j = 0 \quad \text{if} \quad A_j \in \{1\} \quad j \in MC^{SM} \tag{7.18}$$

The customer value expected by the applicator (ECV_C) can be explained in the same way as in the case of non-cooperative VCM. The way it is calculated is also similar [see Eqs. (7.8), (7.9), and (7.10)].

Comparison of the Offered and the Expected Customer Value

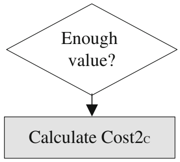


An innovation is accepted if the value offered by the supplier and the manufacturer (CV_C) is higher than or equal to the value expected by the applicator (ECV_C). Otherwise, the innovation is rejected. This evaluation process follows Eq. (7.19). It is the less critical step in cooperative VCM as the manufacturer supports the supplier during the whole interaction process. This implies that the supplier can profit from the manufacturer's experience in interacting with the applicator.

$$Acceptance\!:\begin{cases} yes,\ if\ CV_C \geq ECV_C \\ no,\ if\ CV_C < ECV_C \end{cases} \tag{7.19}$$

Once again, at this stage, the supplier has performed a full VCM process and has interacted with other agents in the value chain. Therefore, the supplier's kene set is improved to reflect this learning process. The amount of within-field knowledge and expertise of the triples used in the joint marketing concept are increased by one.

Calculation of the Cooperative Marketing Cost 2 ($Cost2_c$)



The second cost factor in cooperative VCM represents the cost needed to explain the value of the innovation to the applicator. Similar to the second cost factor in non-cooperative VCM, the cost is proportional to the difference between CV_C and ECV_C. The calculation of the second cost factor follows Eq. (7.20). This equation is similar to other cost factor equations. The usage of the constant $C2_C$ also follows the same logic. More details on the cost calculation can be found in Appendix C1.

$$Cost2_C = (C2_c \times |CV_C - ECV_C|) \tag{7.20}$$

7.4.5 Input and Output

Inputs are the environmental conditions that influence the output of the simulation. In this model, there are several inputs whose values can be set by users. These inputs are listed in Table 7.7. How to use these input parameters will be explained in Sect. 7.7 when introducing the simulation experiment.

The marketing strategy (m) is selected by users to simulate cooperative VCM, non-cooperative VCM, or a mixture of both marketing strategies. The number of suppliers (N_S), the number of manufacturers (N_M), and the number of applicators (N_A) can be adjusted to build different environments with different proportions of agent types. Some suppliers can be set to have more capital than the rest of the suppliers using the big supplier's ratio (b) input. This input is needed to create a more similar situation to the real world where there are some suppliers that are bigger than others. In addition, there is an innovation rate (r) input where the user can set the number of supplier innovations or the number of active suppliers in the model. As mentioned before, a supplier is active if he has an innovation and tries to promote and implement it. At last, users can set the initial marketing capital (c) owned by the suppliers.

The outputs are the outcomes that are obtained after running the simulation model. In order to achieve the objective of this model, there are a number of outputs that need to be analyzed as listed in Table 7.8. The marketing success (S) is the result of the marketing attempt whether the innovation is accepted and implemented or rejected. The implementation time (IT) describes the total number of attempts by the supplier to implement his present innovation. It thus describes the duration of the implementation process. Finally, the marketing costs are to be recorded as the spent as total implementation costs (IC).

Table 7.7 List of inputs

Symbol	Description	Value
m	VCM strategy	(coop., non-coop., random)
N_S	Number of suppliers	$0 \leq N_S \leq 100$
N_M	Number of manufacturers	$0 \leq N_M \leq 100$
N_A	Number of applicators	$0 \leq N_A \leq 100$
b	Big supplier's ratio	$0 \leq b \leq 50$ %
r	Innovation rate (number of active suppliers)	$0 \leq r \leq 50$ %
c	Initial marketing capital	$0 \leq c \leq 50$

Table 7.8 List of outputs

Symbol	Description	Value
S	Marketing success	(acceptance, rejection)
IT	Implementation time	$n \in Z$
IC	Implementation costs	$Sum \in R$

7.4.6 *Multi-Agent Features*

The main process in the model has been described. It serves as a generic VCM process. In the real business environment, there is always more complexity. One aspect that should be included in the model is the competition between agents. To reproduce the competition aspect, some additional features are added. These features basically enable the agents to adapt and learn during the marketing process. These will also bring more complexity in the agent's interactions.

The first feature is the supplier's preference in selecting a (potential) business partner. Once a supplier is successful in addressing an agent (i.e. manufacturer or applicator), he will remember that and will try to target this agent again. This procedure is also based on the *SKIN model* where previously good experience with former contacts militates in favor of renewing a partnership (see Ahrweiler et al. 2004). Schulze (2012) also suggests that a firm should select a partner that it is familiar with in order to get optimal results in collaboration.

Applicators also have their preference. It is possible that more than one supplier target an applicator and try to promote their innovations. In these cases, the applicator would definitely like to listen to the offers of the different suppliers and try to find which one is most suitable to his needs. Therefore, applicators are given the ability to listen and speak to a maximum of three suppliers. Each supplier goes through the same VCM process, but the final selection is based on the customer value offered by the supplier. In fact, the supplier innovation that offers the highest customer value will be accepted by the applicator (cf. Case 2). Regarding the *SKIN model*, the end user selects the product with the cheapest price (Ahrweiler et al. 2004, p. 4).

7.5 Model Implementation

To implement the VCM model, NetLogo is used as the most popular agent-based simulation environment (Wilensky 1999). In general terms, it is used for simulating complex systems evolving over time. This specific system is based on Java version 1.4. The Java script is chosen due to its performance and the potential to run the system on different platforms (see Tisue and Wilensky 2004). The language NetLogo is developed as an advancement of a further program called StarLogo. NetLogo is a member of the List Processing language (LISP) family by which the source code is described by linked lists. The major advantage of the NetLogo language is its simplicity which enables researchers to build own models without any prior programming knowledge. Also, the code is simple so that external users can use other models to understand and can use fragments of these models for their own model. Thereby, NetLogo stands out as the quickest to learn and the easiest to use simulation program (Gilbert 2008). A large community exists where members publish their own model and support each other. The first step into NetLogo is to explore the more than 140 pre-built simulations which can be found in the model library.

The NetLogo system includes three tabs. The Interface tab is used to define different settings and to visualize the output of the agent-based simulation (see Fig. 7.14).

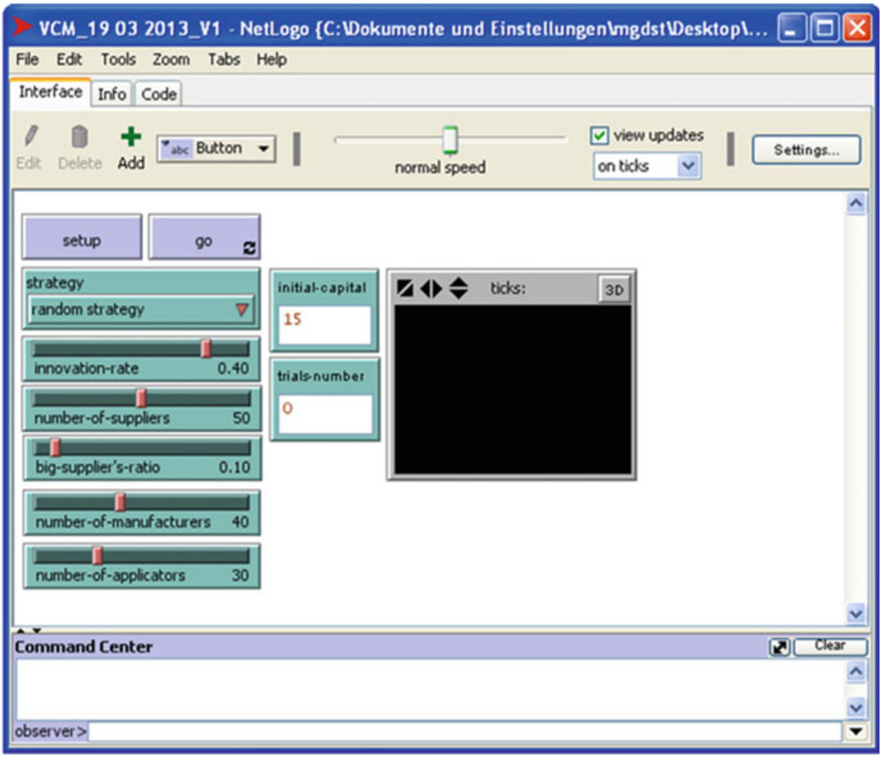


Fig. 7.14 NetLogo interface

The Information tab includes the text-based documentation of what the simulation is for and what has to be observed. The Procedure tab is the tab where the researcher writes the simulation program using the NetLogo language. The program itself consists of three parts. The first part provides information on the types of agents in the model and the variables that are accessible for every type of agent, i.e. global variables. In the NetLogo program, global variables can be created in two different ways. There are global variables set with the slider or chooser button in the interface. Other global variables are set within the code by using the globals keyword at the beginning of the procedure. The second part is a setup procedure that initializes the simulation. The setup button takes all the inputs which are set in the NetLogo interface and initializes the different breeds or types of agents. The third part describes the go procedure which is executed again and again by the system in order to run the simulation. The go function is executed by the go button in the NetLogo interface. A full documentation of the final program code can be found in Appendix C2.

7.6 Model Verification

After building an agent-based model, the researcher takes some steps to properly use this methodology. One of them is the step of verification which refers to "the task of ensuring that a model satisfies the specification of what it is intended to do" (Gilbert 2008, p. 31). Modelers often refer to a more informal term and describe this process as debugging (see Galán et al. 2009; Smith and Conrey 2007). According to Davis et al. (2007), verification is important to increase the trustworthiness of simulation results. Boero and Squazzoni (2005) state that it helps to standardize and communicate simulation results.

Although it is a frequently discussed topic, there is no standardized process or checklist how to verify the implemented model. However, Kahl (2012) summarizes the most important things that can be done to fulfill the task of verification. She bases her suggestions on expert opinions and divides the process of verification into five steps: coding, documenting, observing, testing, and comparing. In the next paragraph, the requirements of the different steps are presented. Next, a description of how these steps or aspects are fulfilled in this model follows.

Step 1: Coding—Requirements

- Use an object-oriented language to test if something is missing in the program (Kahl 2012; Gilbert 2008).
- Choose variable names that are meaningful to facilitate the evaluation of the model-to-program completion (Kahl 2012; Gilbert 2008; Balci 1994).
- Take enough time and care to write the code in order to avoid programming bugs (Kahl 2012; Gilbert 2008).

- Look for a second programmer who also codes the model (Smith and Conrey 2007) or find at least a researcher who proofreads the code (Balci 1994).
- Add assertions to test if input parameter values make sense (Gilbert 2008).
- Use unit testing which consists of writing some test code to develop the program in small and exercise it at the same time (Gilbert 2008).

Step 1: Coding—Fulfillment
- NetLogo 5.0.1 is used. It is an object-oriented language.
- Meaningful variables names are selected and used.
- Sufficient time is allocated to write the code.
- Another researcher is asked to proofread parts of the VCM model.
- Assertions are added to ensure that the parameter values make sense.
- Extra pieces of program code are added to the different procedures to test input and output plausibility.

Step 2: Documenting—Requirements
- Add comments to the code and describe what the different lines are supposed to achieve (Kahl 2012; Gilbert 2008).
- Choose another verbal form to document the model and to check for its completeness (Kahl 2012). The ODD protocol (Grimm et al. 2010, 2006) and the NetLogo information tab (Wilensky 1999) present two alternatives.

Step 2: Documenting—Fulfillment
- Comments are added to the code to improve transparency of the procedures.
- The ODD protocol and the NetLogo information tab are used.

Step 3: Observing—Requirements
- Program some output diagnostics to facilitate bug detection (Kahl 2012; Gilbert 2008; Balci 1994). These diagnostics can be deleted in the final model version. Also, graphical displays are useful to track the behavior of variables (Gilbert 2008; Davis et al. 2007; Balci 1994).
- Examine the program code step by step. This means to run lines or procedures individually and check their output (Gilbert 2008).
- Program output tables to check the functionality of the procedures.

Step 3: Observing—Fulfillment
- Some output diagnostics are programmed in the NetLogo interface (Wilensky 1999). They are deleted in the final model version.
- During model building, individual procedures are run singly and their output is checked in the NetLogo command center (Wilensky 1999).
- Output tables are programmed and checked.

Step 4: Testing—Requirements

- Test scenarios for which the parameter and the output values are known (Gilbert 2008). Build a set of test scenarios (Gilbert and Troitzsch 2005). Run the program with extreme conditions to test if the assumptions of the model hold (Kahl 2012; Gilbert 2008; Davis et al. 2007; Troitzsch and Gilbert 2005).
- Use statistical testing to check if the simulation model is able to replicate assumptions made in the theoretical model (Kahl 2012).

Step 4: Testing—Fulfillment

- Scenarios for which output parameter values are known are tested before the experimental stage.
- Test scenarios are built. The program is run with extreme conditions.
- Statistical tests are used to back up the observations of the modeler.

Step 5: Comparing—Requirement

- Compare the simulation results with the assumptions made in the theoretical model. If both match, "the theoretical logic and its computational representation are likely to be correct" (Davis et al. 2007, p. 491).

Step 5: Comparing—Fulfillment

- After each experiment, the simulation results are documented and then compared with the assumptions made in the theoretical model.

7.7 Experimental Design

The implemented VCM model programmed in NetLogo 5.0.1 serves as a starting point for the simulation experiment. As mentioned, this model is used to analyze the marketing performance of suppliers' attempts to implement their innovations and pursues two targets. The first target is to compare the marketing performance of cooperative and non-cooperative VCM. The second target is to study the effect of the critical success factors, i.e. the newness of innovation and the knowledge overlap, through a relative comparison of the supplier's marketing performance of both VCM strategies.

To prepare the simulation experiment, different steps need to be taken. First, the variables of the model have to be classified as independent, dependent, and control variables (see Fig. 7.15). Based on this classification, the investigated relationships in the model can be described as the effect that the VCM strategy, the newness of innovation, and the knowledge overlap have on the marketing success, the implementation time, and the implementation costs. Marketing success indicates the average result of a supplier's attempt to implement a present innovation. Implementation time refers to the average number of attempts a supplier spends to successfully perform a marketing attempt. Implementation costs are measured by the average amount of related costs to implement a current innovation.

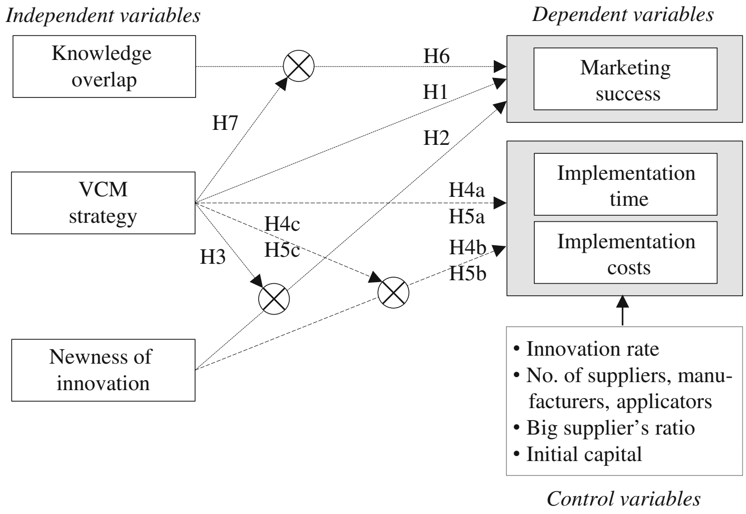


Fig. 7.15 Classification of variables and their hypothesized relationships

The variables innovation rate, number of suppliers, number of manufacturers, number of applicators, big supplier's ratio, and initial capital are classified as control variables. These variables remain fixed as their variation is not of interest in the context of the formulated research questions.

In the simulation study, the order of the hypothesized relationships presented at the end of Chap. 6 is modified. It helps to display the simulation results in a structured way.

Within the simulation experiment, independent variables are analyzed as factors and dependent variables as response variables (see Table 7.9). The factors consist of two or three levels: VCM strategy (m) comprises cooperative and non-cooperative ones. Newness of innovation (n) includes process driven, functionality driven, and really new ones. Knowledge overlap (o) can be small, medium, and high. The response variables are abbreviated by the letters S (marketing success), IT (implementation time), and IC (implementation costs).

Next, an experimental roadmap or design of experiment (DOE) is developed to organize the simulation experiment. In this context, a factorial design is the preferred technique to select factor levels that should be systematically analyzed. Furthermore, it facilitates the analysis of interaction effects hypothesized in Sect. 6.7. The combinations of factor levels are known as design points. They define the simulation settings and are listed in a design matrix (see Sect. 7.8).

To perform the simulation experiment, the number of runs required per simulation setting has to be determined beforehand. One appropriate method to define the number of simulation runs is to estimate the experimental error variance (see Lorscheid et al. 2012). This estimation includes the calculation of the mean and the coefficient of variance for the increasing number of simulation runs and all response variables. To calculate the coefficient of variance, the researcher starts the

Table 7.9 Definition of factors, factor level ranges, and response variables

Classification of variables	Table of factors	Factor level ranges
Independent variables VCM strategy	*Factors* m (VCM strategy)	{cooperative, non-cooperative}
Newness of innovation	n (Newness of innovation)	{process driven, functionality driven, really new}
Knowledge overlap	o (Knowledge overlap)	{small, medium, high}
Control variables No. of suppliers	*Control variables* N_S (No. of suppliers)	{30, 40, 50, 60}
No. of manufacturers	N_M (No. of manufacturers)	{20, 30, 40, 50}
No. of applicators	N_A (No. of applicators)	{10, 20, 30, 40}
Big supplier's ratio	b (Big supplier's ratio)	{0.00, 0.10, 0.20}
Initial capital	c (Initial capital)	{10, 20, 30}
Dependent variables Marketing success	*Response variables* S (Marketing success)	
Implementation time	IT (Implementation time)	
Implementation costs	IC (Implementation costs)	

simulation and repeats it with a fixed simulation setting for a relatively low number of runs. The values of all response variables are measured and documented for each run. In this model, one simulation run is completed if all active suppliers implement their innovations successfully or run out of capital. The response variable values are used to calculate the mean and coefficient of variance. Next, the number of simulation runs is increased iteratively to stabilize the variability of the response measures and the coefficient of variance. The procedure is repeated as long as the coefficient of variance is stable, i.e. it does not change anymore. As noted by Lorscheid et al. (2012), the reached stability is used as the stopping criterion. It highlights the number of simulation runs that are necessary to calculate the response variables in the subsequent simulation experiment. Finally, the results are documented in an error variance matrix.

After describing DOE, factorial design, and error variance in theory, they need to be applied to the simulation model. The output file produced at the end of each simulation run is divided into three separate data sets. This is based on the fact that different research questions have to be answered. The *first research objective* is to compare the marketing effectiveness of cooperative and non-cooperative VCM attempts. Therefore, the average marketing success (S) of both VCM strategies has to be determined. The respective data set (*data set I*) includes all successful and failed marketing attempts of suppliers.

Table 7.10 presents the selected factors and the factor level ranges for the first data set. The first factor marketing strategy (m) comprises two levels: cooperative

Table 7.10 DOE and factor level for the 1st factorial design

DOE: Research objective "Comparing the marketing effectiveness of VCM strategies" Sample: successful and failed marketing attempts		
Factors	**Factor level range**	**Response**
VCM strategy (*m*)	∈ {0,1}	Marketing success (*S*)
Newness of innovation (*n*)	∈ {1,2,3}	

Factors	**Factor level range**	**Factor levels**	**Representation**
m	∈ {0,1}	(0,1)	(c-VCM, nc-VCM)
n	∈ {1,2,3}	(1,2,3)	(PDI, FDI, RNP)

Table 7.11 Error variance matrix (data set I)

	Number of simulation runs						
Dependent variables and measures	80	160	320	640	1,280	2,560	5,120
Design point 1 (*m* = *c-VCM*; *n* = *PDI*) S (Marketing success)							
MEAN	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VARIANCECOEFF	–	–	–	–	–	–	–
Design point 2 (*m* = *c-VCM*; *n* = *FDI*) S (Marketing success)							
MEAN	0.69	0.70	0.68	0.68	0.70	0.69	0.69
VARIANCECOEFF	0.68	0.66	0.68	0.68	0.65	0.67	0.67
Design point 3 (*m* = *c-VCM*; *n* = *RNP*) S (Marketing success)							
MEAN	0.11	0.15	0.15	0.16	0.16	0.15	0.15
VARIANCECOEFF	2.79	2.37	2.42	2.29	2.29	2.34	2.38
Design point 4 (*m* = *nc-VCM*; *n* = *PDI*) S (Marketing success)							
MEAN	0.31	0.31	0.33	0.31	0.30	0.33	0.32
VARIANCECOEFF	1.48	1.51	1.43	1.50	1.52	1.44	1.46
Design point 5 (*m* = *nc-VCM*; *n* = *FDI*) S (Marketing success)							
MEAN	0.59	0.59	0.61	0.61	0.60	0.60	0.61
VARIANCECOEFF	0.83	0.83	0.81	0.81	0.82	0.81	0.79
Design point 6 (*m* = *nc-VCM*; *n* = *RNP*) S (Marketing success)							
MEAN	0.56	0.46	0.53	0.50	0.51	0.50	0.50
VARIANCECOEFF	0.89	1.08	0.95	1.00	0.98	0.99	1.00

VCM (0), represented by c-VCM and non-cooperative VCM (1), represented by nc-VCM. The second factor newness of innovation (*n*) includes three levels: process-driven innovation (1), represented by PDI; functionality-driven innovation (2), represented by FDI; and really new product (3), represented by RNP.

Table 7.12 DOE and factor level for the 2nd factorial design

DOE: Research objective "Comparing the marketing efficiency of VCM strategies" Sample: successful marketing attempts		
Factors	**Factor level range**	**Responses**
VCM strategy (*m*)	∈ {0,1}	Implementation time (*IT*)
Newness of innovation (*n*)	∈ {2,3}	Implementation costs (*IC*)

Factors	**Factor level range**	**Factor levels**	**Representation**
m	∈ {0,1}	(0,1)	(c-VCM, nc-VCM)
n	∈ {2,3}	(2,3)	(FDI, RNP)

As mentioned before, pre-experimental simulations are required to evaluate the error variance. To support the analysis, an error variance matrix is used to structure the recorded response variables. Table 7.11 shows the error variance matrix of data set I. It includes the mean value and the coefficient of variance of the response variable *S*. The table indicates that the variance stabilizes after 2,560 runs. Therefore, all simulation outputs will be calculated with over 2,560 runs for the following analysis.

The *second research objective* of the simulation study is to compare the marketing efficiency, i.e. the time (*IT*) and money (*IC*) required to successfully implement a supplier innovation via cooperative or non-cooperative VCM (see Table 7.12). The respective data set (*data set II*) includes all successful marketing attempts of suppliers.

It has to be noted that the newness of innovation (*n*) comprises only two levels: functionality-driven innovation (FDI) and really new product (RNP). Based on the case study results that are used to set the agents' rules of behavior, process-driven innovations cannot be implemented successfully via cooperative VCM. Consequently, this type of innovation is excluded from the following analysis.

Table 7.13 presents the error variance matrix of data set II. It includes the mean value and the coefficient of variance of the response variables *IT* and *IC*. As in the first data set, the variance stabilizes after 2,560 simulation runs.

The *third objective* focuses on the effect of knowledge overlap on the marketing success of cooperative and non-cooperative VCM. Compared to the first data set, *data set III* includes every single step of a successful or failed marketing attempt. Table 7.14 shows the selected factors and the factor level ranges for the third data set. Besides the factors VCM strategy (*m*) and newness of innovation (*n*), the third factor knowledge overlap (*o*) with three levels is considered: small overlap (1), represented by +; medium overlap (2), represented by ++; and high overlap (3), represented by +++.

Table 7.15 shows the error variance matrix of data set III. It includes the mean value and the coefficient of variance of the response variable *S*. As in the first two data sets, the variance of data set III stabilizes after 2,560 simulation runs.

Table 7.13 Error variance matrix (data set II)

Dependent variables and measures	Number of simulation runs						
	80	160	320	640	1,280	2,560	5,120
Design point 2 (m = c-VCM; n = FDI)							
IT (Implementation time)							
MEAN	1.95	1.91	1.95	1.87	1.93	1.93	1.91
VARIANCECOEFF	0.49	0.52	0.52	0.52	0.51	0.51	0.51
IC (Implementation costs)							
MEAN	11.99	11.20	11.64	11.59	11.69	11.67	11.51
VARIANCECOEFF	0.51	0.51	0.49	0.51	0.49	0.49	0.50
Design point 3 (m = c-VCM; n = RNP)							
IT (Implementation time)							
MEAN	3.65	4.22	4.23	4.12	4.25	4.20	4.18
VARIANCECOEFF	0.61	0.64	0.61	0.65	0.64	0.65	0.64
IC (Implementation costs)							
MEAN	13.53	15.07	15.43	14.67	15.23	14.85	14.94
VARIANCECOEFF	0.42	0.46	0.42	0.45	0.43	0.44	0.43
Design point 5 (m = nc-VCM; n = FDI)							
IT (Implementation time)							
MEAN	1.66	1.67	1.64	1.64	1.64	1.66	1.64
VARIANCECOEFF	0.35	0.37	0.37	0.36	0.36	0.37	0.37
IC (Implementation costs)							
MEAN	14.03	14.13	13.96	13.75	13.70	13.88	13.82
VARIANCECOEFF	0.45	0.49	0.49	0.50	0.50	0.50	0.50
Design point 6 (m = nc-VCM; n = RNP)							
IT (Implementation time)							
MEAN	1.62	1.65	1.70	1.67	1.69	1.67	1.66
VARIANCECOEFF	0.38	0.40	0.38	0.38	0.38	0.38	0.38
IC (Implementation costs)							
MEAN	15.16	15.35	15.32	15.42	15.59	15.49	15.47
VARIANCECOEFF	0.49	0.47	0.45	0.46	0.46	0.46	0.46

Table 7.14 DOE and factor level for the 3rd factorial design

DOE: Research objective "Exploring the effect of knowledge overlap"
Sample: every step of successful and failed marketing attempts

Factors	**Factor level range**	**Response**
VCM strategy (*m*)	$\in \{0,1\}$	Marketing success (*S*)
Newness of innovation (*n*)	$\in \{1,2,3\}$	
Knowledge overlap (*o*)	$\in \{1,2,3\}$	

Factors	**Factor level range**	**Factor levels**	**Representation**
m	$\in \{0,1\}$	(0,1)	(c-VCM, nc-VCM)
n	$\in \{1,2,3\}$	(1,2,3)	(PDI, FDI, RNP)
o	$\in \{1,2,3\}$	(1,2,3)	(+, ++, +++)

Table 7.15 Error variance matrix (data set III, abstract)

Dependent variables and measures	Number of simulation runs						
	80	160	320	640	1,280	2,560	5,120
Design point 5 (*m* = *c-VCM*; *n* = *FDI*; *o* = ++)							
S (Marketing success)							
MEAN	0.11	0.14	0.15	0.14	0.16	0.16	0.16
VARIANCECOEFF	2.89	2.43	2.34	2.45	2.31	2.27	2.26
Design point 6 (*m* = *c-VCM*; *n* = *FDI*; *o* = +++)							
S (Marketing success)							
MEAN	0.36	0.36	0.36	0.36	0.36	0.36	0.36
VARIANCECOEFF	1.35	1.35	1.35	1.34	1.33	1.35	1.34
Design point 8 (*m* = *c-VCM*; *n* = *RNP*; *o* = ++)							
S (Marketing success)							
MEAN	0.05	0.05	0.05	0.05	0.06	0.05	0.05
VARIANCECOEFF	4.49	4.58	4.48	4.47	4.11	4.30	4.26
Design point 11 (*m* = *nc-VCM*; *n* = *PDI*; *o* = ++)							
S (Marketing success)							
MEAN	0.05	0.07	0.08	0.07	0.08	0.08	0.08
VARIANCECOEFF	4.27	3.53	3.40	3.52	3.49	3.35	3.38
Design point 14 (*m* = *nc-VCM*; *n* = *FDI*; *o* = ++)							
S (Marketing success)							
MEAN	0.41	0.40	0.40	0.40	0.38	0.39	0.40
VARIANCECOEFF	1.38	1.22	1.24	1.23	1.27	1.25	1.23
Design point 17 (*m* = *nc-VCM*; *n* = *RNP*; *o* = ++)							
S (Marketing success)							
MEAN	0.34	0.34	0.34	0.33	0.33	0.33	0.32
VARIANCECOEFF	1.38	1.39	1.41	1.42	1.42	1.44	1.45

7.8 Analyses and Results

After answering the question of the required number of runs, the simulation experiment is performed. Next, the effect analysis of the different factors is conducted for the output data of the VCM model. In this dissertation, sensitivity analysis is used to determine which model aspects have a "significant impact on the desired measures of performances" (Law 2007, p. 258). This means varying the values of input parameters to check which ones are sensitive, i.e. produce significant differences in the model's output parameters. Analyzing the interaction effects, the sensitivity analysis helps to test the robustness of cooperative and non-cooperative VCM and thus support suppliers' decision making.

To study the factor effects in a systematic way, the analysis has to be divided into two steps (Lorscheid et al. 2012). In the first step, factors are tested for significant effects on the simulation response. This implicates that a two- or three-way independent ANOVA is conducted. The results of each ANOVA are presented in a table that shows the output of the "Tests of Between-Subjects Effects". In the second step, the effect size of each significant factor effect is calculated. According to Law (2007), the main effect of a factor describes the average difference in the response when this factor is at its "high" level as opposed to its "low" level. Additionally, eta squared, partial eta squared, and omega squared are calculated for each effect.

Eta squared (η^2) refers to the proportion of the total variance that is attributed to an effect (see e.g. Tabachnick and Fidell 2007). It is calculated as the ratio of the effect variance (SS_{effect}) to the corrected total variance (SS_{error}) [see Eq. (7.21)].

$$\eta^2 = \frac{SS_{effect}}{SS_{total}} \tag{7.21}$$

Partial eta squared (*partial* η^2 is part of the SPSS output and describes the proportion of the effect plus the error variance that is attributed to the effect (see e.g. Tabachnick and Fidell 2007). The formula differs from the eta squared formula in that the denominator includes SS_{effect} plus SS_{error} rather than SS_{total} [see Eq. (7.22)].

$$Partial\ \eta^2 = \frac{SS_{effect}}{SS_{effect} + SS_{error}} \tag{7.22}$$

Omega squared (ω^2) is an estimation of the dependent variance accounted by for the independent variable in the population for a fixed effects model (see e.g. Tabachnick and Fidell 2007; Olejnik and Algina 2003). The between-subjects, fixed effects form of the formula is presented in Eq. (7.23).

$$\omega^2 = \frac{\left(SS_{effect} - \left(df_{effect}\right)\left(MS_{error}\right)\right)}{MS_{total} + SS_{total}} \tag{7.23}$$

To structure the experiment, a design matrix for each data set is developed and contains all factor level combinations as well as the simulation response (Law 2007). The response values are calculated per design point based on the simulation output.

7.8.1 Analysis I: Marketing Success or Effectiveness

Table 7.16 depicts the design matrix of data set I with over 2,560 runs. As mentioned, data set I comprises all successful and failed marketing attempts of suppliers. In sum, there are 51,200 cases: 25,488 cooperative and 25,712 non-cooperative VCM cases. For each run i, the value S_i is calculated as the average

Table 7.16 Design matrix (data set I)

Design point	Factors		Response
	m	*n*	*S*
1	c-VCM	PDI	0.000
2	c-VCM	FDI	0.692
3	c-VCM	RNP	0.154
4	nc-VCM	PDI	0.325
5	nc-VCM	FDI	0.604
6	nc-VCM	RNP	0.504

result of a supplier's marketing attempt to implement his innovation. As a reminder, the combinations of factor levels are known as design points. They define the simulation settings and are listed in a design matrix. The factor VCM strategy (*m*) includes two levels: cooperative (c-VCM) and non-cooperative VCM (nc-VCM). The factor newness of innovation (*n*) comprises three levels: process-driven innovation (PDI), functionality-driven innovation (FDI), and really new product (RNP). An overview of the descriptive statistic can be found in Appendix C3.

Next, the effect analysis of all factors is performed for data set I in two steps (see Lorscheid et al. 2012). In the first step, the factors are tested for significant effects on the simulation responses. To test the significance, a two-way independent ANOVA is performed. Table 7.17 shows the output of the "Tests of Between-Subjects Effects" for data set I when studying the response variable marketing success (*S*). The factors VCM strategy (*m*) and newness of innovation (*n*) have significant effects. Moreover, a significant 2-factor interaction effect is identified between the factors *n* and *m*.

In the second step, the effect size of the significant factor effects VCM strategy (*m*) and newness of innovation (*n*) is calculated. The effect matrix (see Table 7.18) shows all factor effects and the 2-factor interaction effect on marketing success (*S*) is calculated as the average difference in the response when a factor is at its "high" level as opposed to its "low" level (cf. Law 2007).

Remarkable, factor *m* and *n* are characterized by a different number of attribute levels. Factor *m* has two levels (cooperative and non-cooperative VCM) and factor *n* consists of three levels (process-driven innovation, functionality-driven innovation, and really new product). This implicates that the effect size of the main effect *n* on *S* as well as the interaction effect between *n* and *m* on *S* is divided into three values: from process-driven innovation (PDI) to functionality-driven innovation (FDI), from functionality-driven innovation (FDI) to really new product (RNP), and from process-driven innovation (PDI) to really new product (RNP). An exemplary calculation is shown in Fig. 7.16.

Table 7.17 ANOVA for main and interaction effect (data set I)

Source	Type III sum of squares	df	Mean square	F	Sig.
Main effect of *m*	404.775	1	404.775	2,095.878	0.000
Main effect of *n*	1,883.919	2	941.959	4,876.137	0.000
$m \times n$	586.115	2	293.057	1,517.03	0.000
Error	9,889.524	51,194	0.193	8	
Total	22,740.000	51,200			
Corrected total	12,640.242	51,199			

$R^2 = 0.218$ (adjusted $R^2 = 0.218$)

Table 7.18 Effect matrix (data set I)

	Factors	
Factors	*m*	*n*
m	0.196	0.012 [−0.207; 0.219]
n		0.166 [0.485; −0.319]

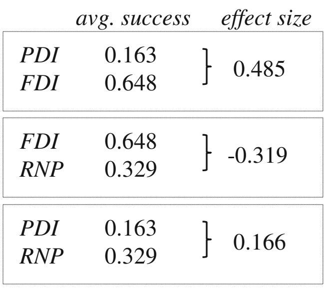


Fig. 7.16 Calculation of the effect size of the main effect n on S

7.8.1.1 VCM Strategy

As visualized in Fig. 7.17, the calculated effect size of the main effect *m* on *S* is *0.196*. Alternative effect size measures are: $\eta^2 = 0.032$; *partial* $\eta^2 = 0.039$; $\omega^2 = 0.032$. Cohen (1977) calls omega squared (ω^2) "large" when over 0.15, "medium" when 0.06–0.15, and otherwise "small". Following this effect size convention, the VCM strategy (*m*) indicates a rather small but significant effect on the marketing success (*S*).

Result 1: The data demonstrate that the choice of VCM strategy has an impact on the success or effectiveness of a supplier's marketing attempt to implement an innovation. Compared to cooperative VCM, non-cooperative VCM is the more effective marketing strategy (0.282 vs. 0.478). Based on this insight, *H1* is supported.

As noted in Sect. 7.4.4, each supplier innovation has to fulfill two critical thresholds. The first threshold describes the match of marketing objectives. The second one refers to the match of customer values. A close consideration of the simulation data indicates that most cooperative attempts have problems in

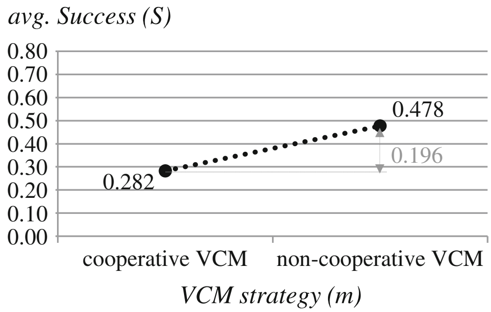


Fig. 7.17 Main effect VCM strategy (m) on marketing success (S)

overcoming the first threshold. Expressed in figures, only 16.2 % of the *cooperative attempts* take the first threshold. This can be explained by the predominantly antagonistic attitude of manufacturers toward supplier innovations (see Sect. 3.3.1). They expect a perfect match, i.e. an urgent need verbalized by an applicator. Supplier innovations that correspond to future or latent needs of applicators are hampered by the intermediate stage as long as possible. Even if the success rate of cooperative attempts is 46.0 % in the second step, it could not compensate the persistent innovation resistance of manufacturers in the first step.

In turn, 65.4 % of the *non-cooperative attempts* take the first threshold. In these cases, applicators are addressed first by the supplier. They are characterized by a protagonistic attitude toward supplier innovations and only expect a partial match (see Sect. 3.3.3). This means that innovations that fulfill future or latent needs can also be implemented via non-cooperative VCM. The openness of applicators helps to provide a higher success rate although suppliers have more difficulties to overcome the second threshold (36.4 %).

7.8.1.2 Newness of Innovation

The calculated effect size of the main effect n on S is *0.166* [*0.485*; *−0.319*] and is illustrated in Fig. 7.18. Alternative effect size measures here are: $\eta^2 = 0.149$; *partial* $\eta^2 = 0.160$; $\omega^2 = 0.149$. In contrast to the VCM strategy, the newness of innovation (n) has a large significant effect on the marketing success (S).

Result 2: The data indicate that the newness of innovation has a strong impact on the marketing effectiveness. The more the supplier innovation focuses on the functionality aspect and thus on the core business of the final applicator, the higher the marketing effectiveness. In consequence, *H2* is supported.

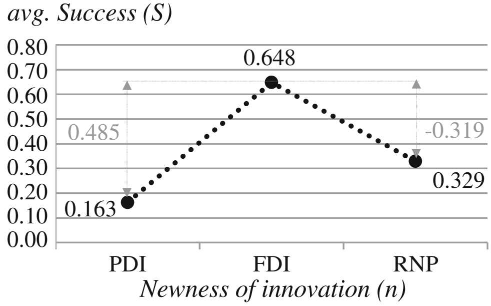


Fig. 7.18 Main effect newness of innovation (n) on marketing success (S)

7.8.1.3 Interaction Between Newness of Innovation and VCM Strategy

Finally, the interaction effect between n and m on S is calculated and is illustrated in Fig. 7.19. It is *0.012* [*−0.207*; *0.219*]. Alternative effect size measures are: $\eta^2 = 0.046$; *partial* $\eta^2 = 0.056$; $\omega^2 = 0.046$. Following the effect size convention of Cohen (1977), the interaction effect is rather small but it is significant.

Result 3: The result indicates that the impact of the newness of innovation on the marketing effectiveness is higher in the case of cooperative VCM. Based on this insight, *H3* is supported.

More precisely, process-driven innovations and really new products are implemented more effectively via non-cooperative VCM. Both strategies lead to a similar success rate when marketing functionality-driven innovations. In these cases, the difference between cooperative and non-cooperative VCM is quite small, with a slight preference for cooperative VCM. Further, the data demonstrate that the success rate of cooperative VCM is reduced if the innovation also requires changes in the production process. This observation motivates a more detailed analysis of the average success rate for the different types of innovations.

Within the analysis, 17,824 cases are extracted where the supplier tries to implement *functionality-driven innovations* (*FDIs*) via non-cooperative VCM. This type of innovation easily fulfills the first threshold (i.e. match of marketing objectives), but it has difficulties to pass the second threshold (i.e. match of customer values). Suppliers overcome the first barrier in 99.7 % of the cases (17,768) but only 38.0 % of these 17,768 FDIs are finally implemented. By contrast, there are 24,095 cases of functionality-driven innovations via cooperative VCM. Here, suppliers get over the first hurdle in 72.4 % of the cases (17,445) and finally implement their FDIs in 44.9 % of these cases (7,827). Consequently, non-cooperative VCM is more effective for FDIs in the first step, whereas cooperative VCM offers advantages in the second step.

This observation is supported by the case study results. In Case 1, the supplier tries to implement a functionality-driven innovation via non-cooperative VCM. The supplier addresses two applicators and takes the first threshold without problems. All involved value-chain actors strive for a solution to the migration problem in

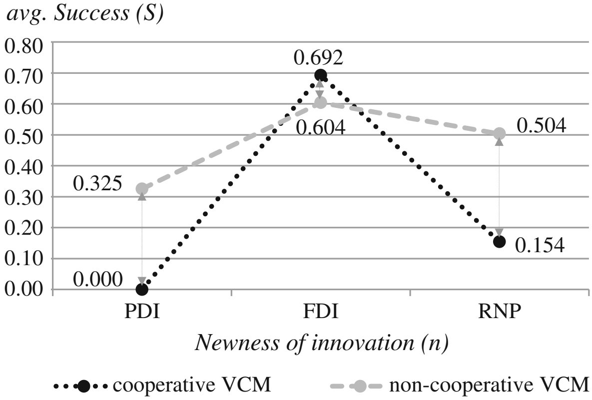


Fig. 7.19 Interaction effect (n × m) on S

cardboard packaging. In the second step, the supplier has difficulties to induce the second applicator to technically implement the said innovation. This is based on the fact that the supplier omits to provide information on the recyclability of the functional barrier solution. In this situation, the integration of the manufacturer could be helpful because he is well-informed on the applicator's requirements and expectations.

In Case 2, two suppliers provide a functionality-driven innovation via non-cooperative VCM. As in Case 1, the suppliers have no difficulties to overcome the first threshold. The common goal in the respective value chain is to solve organoleptic problems in PET bottles. But one of the suppliers fails to take the second threshold because his solution does not fully correspond to the applicator's needs and requirements.

Case 3a demonstrates the problems to overcome the first threshold when pursuing cooperative VCM. Here, the manufacturer hampers the supplier innovation because the applicator does not articulate an urgent need for it. This resistance ties up the entire marketing budget of the supplier and thus delays the implementation of the said innovation.

Regarding *really new products*, 15,087 non-cooperative cases are extracted. As in the case of functionality-driven innovations, the first threshold is easily conquered (95.5 %), but the second one is the sticking point. Only 34.6 % of the really new products (RNPs) are implemented successfully. The cooperative VCM attempts almost always fail the first threshold when marketing RNPs. Here, suppliers only pass the first hurdle in 4.1 % of the cases. But if they overcome this first step, 53.5 % of these RNPs are finally implemented. This could be observed in Case 4 where the first hurdle is taken. In this case, the applicator articulates an urgent need to solve the migration problem in glass packaging. The second threshold could be passed with the help of the manufacturer. He has a close relationship with the applicator and specializes in the field of production processes.

The last type of supplier innovations, *process-driven innovations*, is not implemented via cooperative VCM. All 32,500 cases are hampered by manufacturers because they only support supplier innovations that are proactively demanded by applicators. But applicators mainly focus on product functionality and not on

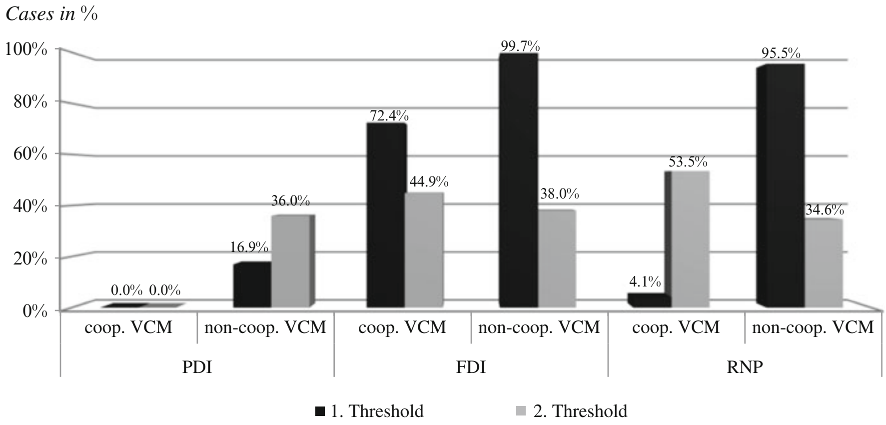


Fig. 7.20 In-depth analysis of the critical thresholds in VCM

process technology. If suppliers select non-cooperative VCM (21,990 cases), they fulfill the first threshold in 16.9 % and the second one in 36.0 % of the cases.

An example: In Case 5, the supplier pursues non-cooperative VCM to promote a process-driven innovation which requires a reformation of the production process by eliminating the coating step—a central production step of the manufacturer. As the elimination dramatically reduces the manufacturer's field of activity and the applicator does not proactively demand this kind of innovation, the supplier pursues non-cooperative VCM to promote it. Otherwise, he would not overcome the first barrier of arousing interest in the value chain. Without doubt, it is difficult to overcome the second barrier of implementing the innovation (i.e. fulfill the applicator's expectations), but the chance for the supplier to be successful is much higher than in the case of cooperative VCM.

Figure 7.20 summarizes the findings of the in-depth analysis of the interaction effect between the newness of innovation and the VCM strategy on the marketing success.

7.8.2 Analysis II: Marketing Efficiency of Successful VCM Attempts

After investigating the success rate of suppliers' marketing attempts in the first analysis, the second analysis goes a step further by considering the successful marketing attempts of suppliers to compare their marketing efficiency (see Fig. 7.21). This implies that the data set of the second analysis includes all successful but excludes all failed marketing attempts of suppliers. In total, there are 22,740 successful cases divided into 9,408 cooperative and 13,332 non-cooperative VCM attempts.

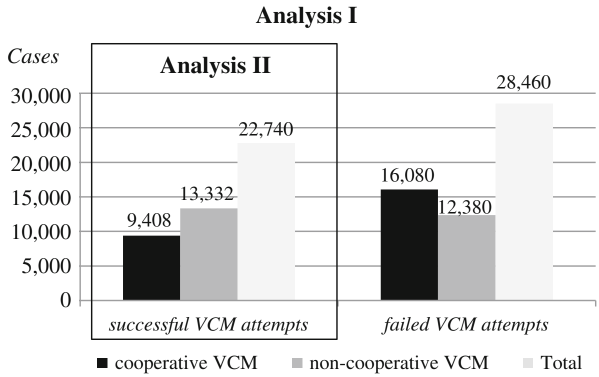


Fig. 7.21 The relevant sample in the second analysis

Table 7.19 Design matrix (data set II)

Design point	Factors		Responses	
	m	*n*	*IT*	*IC*
1	c-VCM	PDI	–	–
2	c-VCM	FDI	1.934	11.688
3	c-VCM	RNP	4.195	13.947
4	nc-VCM	PDI	4.054	14.562
5	nc-VCM	FDI	1.659	13.780
6	nc-VCM	RNP	1.670	15.323

Table 7.19 depicts the design matrix of data set II with over 2,560 runs. For each run *i*, the value IT_i is calculated as the average number of attempts a supplier spends to perform a marketing attempt successfully. IC_i refers to the average amount of related costs to implement an innovation. As mentioned before, process-driven innovations (PDI) cannot be implemented via cooperative VCM. This kind of innovation is not proactively demanded by applicators. It is rejected by manufacturers who expect an urgent need verbalized by the applicator. Thus, the design points 1 and 4 are highlighted in gray and are excluded from the following data analysis (see Table 7.19). An overview of the descriptive statistic can be found in Appendix C3.

7.8.2.1 Implementation Time

At first, the effect analysis focuses on the response variable implementation time (*IT*). To test the significance, a two-way independent ANOVA is conducted. The output of the “Tests of Between-Subjects Effects” for data set II is presented in Table 7.20. The factors VCM strategy (*m*) and newness of innovation (*n*) have significant effects. Furthermore, a significant 2-factor interaction effect is identified between the factors newness of innovation (*n*) and VCM strategy (*m*).

Table 7.20 ANOVA for main and interaction effect (data set II, response variable IT)

Source	Type III sum of squares	df	Mean square	F	Sig.
Main effect of *m*	6,973.552	1	6,973.552	5,181.184	0.000
Main effect of *n*	11,947.655	2	5,973.828	4,438.413	0.000
$m \times n$	4,503.491	1	4,503.491	3,345.987	0.000
Error	30,599.898	22,735	1.346		
Total	142,704.000	22,740			
Corrected total	45,040.857	22,739			

$R^2 = 0.321$ (adjusted $R^2 = 0.320$)

Table 7.21 Effect matrix (data set II, response variable IT)

Factors	Factors: *m*	*n*
m	−1.400	1.125
n		1.136

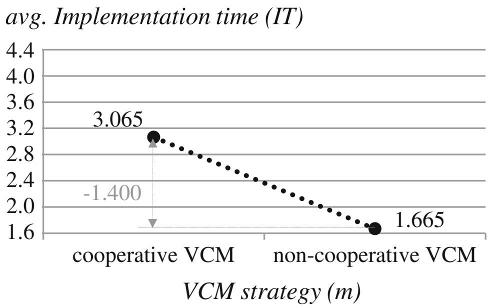


Fig. 7.22 Main effect VCM strategy (m) on implementation time (IT)

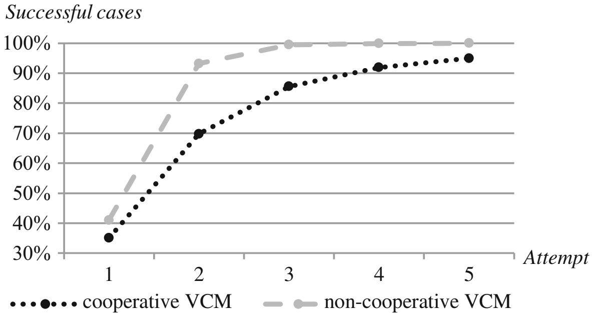
The effect matrix (see Table 7.21) summarizes all factor effects and the 2-factor interaction effect on implementation time (*IT*) is calculated as the difference in the response when a factor is at its "high" level as opposed to its "low" level (cf. Law 2007).

VCM Strategy

As shown in Fig. 7.22, the calculated effect size of the main effect *m* on *IT* is *−1.400*. Alternative effect size measures are: $\eta^2 = 0.155$; *partial* $\eta^2 = 0.186$; $\omega^2 = 0.155$. Following the effect size convention of Cohen (1977), the VCM strategy (*m*) has a large and significant effect on the implementation time (*IT*).

Result 4: The data indicate that suppliers can speed up the implementation of their innovations by pursuing non-cooperative VCM. This is consistent with the pilot and case study results. Consequently, it is reasonable to argue that suppliers have to invest more time to perform cooperative VCM successfully. Based on this result, *H4a* is supported.

Fig. 7.23 Learning effect in successful VCM attempts



As described in Sect. 7.4.4, suppliers learn from previous experience to adapt themselves to the conditions of the respective value chain. But to gain some learning suppliers must interact with applicators, i.e. they have to overcome the first threshold successfully. This is the biggest challenge when using *cooperative VCM* because manufacturers often hamper supplier innovations. Only if the applicator proactively demands the present innovation, the manufacturer has to support the supplier's marketing attempt and thus cannot prevent suppliers from learning. But if the end applicator does not articulate an urgent need for the said innovation, the innovation rests with the manufacturer and learning does not take effect (see Fig. 7.23).

This problem does not exist in *non-cooperative VCM*. Here, the first threshold is easily overcome. With each marketing attempt, suppliers become more practiced and more efficient at interacting with downstream customers. They adapt their knowledge base if there is still room for improvement, i.e. they just have superficial knowledge and low expertise in a certain field. By gaining some learning, suppliers can speed up the implementation of their innovations. This is shown in Fig. 7.23 where the success rate of non-cooperative VCM disproportionately increases from the first to the second attempt. Here, learning has a strong effect on the implementation time of supplier innovations.

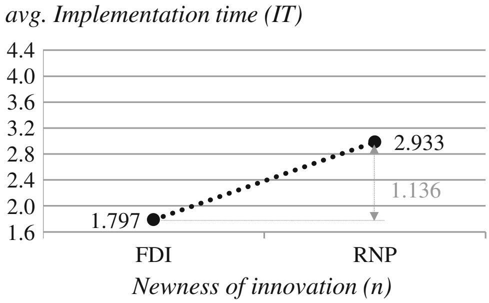
Newness of Innovation

The calculated effect size of the main effect *n* on *IT* is *1.136* and is presented in Fig. 7.24. Alternative effect size measures are: $\eta^2 = 0.265$; *partial* $\eta^2 = 0.281$; $\omega^2 = 0.265$. Like the VCM strategy, the newness of innovation (*n*) has a large significant effect on the implementation time (*IT*).

Result 5: The data demonstrate that functionality-driven innovations are implemented faster than really new products. This type of innovation is close to the core business or competence of downstream customers. In consequence, *H4b* is supported.

In fact, suppliers mainly provide *functionality-driven innovations* (*FDIs*) because they know that applicators proactively demand this kind of innovation (in about 85 % of the cases). With the help of FDIs, applicators can correspond to expressed and future needs of consumers. Suppliers just have to convey product-related information (i.e. information about a product's functional and aesthetic

Fig. 7.24 Main effect newness of innovation (n) on implementation time (IT)



attributes) to convince the applicator. This information is easily available and FDIs are implemented within a short period of time.

If suppliers, in turn, try to implement *really new products* (*RNPs*), i.e. innovations that are rarely demanded by applicators (in about 15 % of the cases), they have to provide information on the product functionality as well as the process technology. But the relevant information on the process technology has still to be gathered as it is not directly available. An example: In Case 4, an intensive search for machinery manufacturers that enables the application of a ring solution is required to ensure the technical implementation of the said innovation. As the information procurement takes some time, the implementation of RNPs is characterized by a longer implementation time.

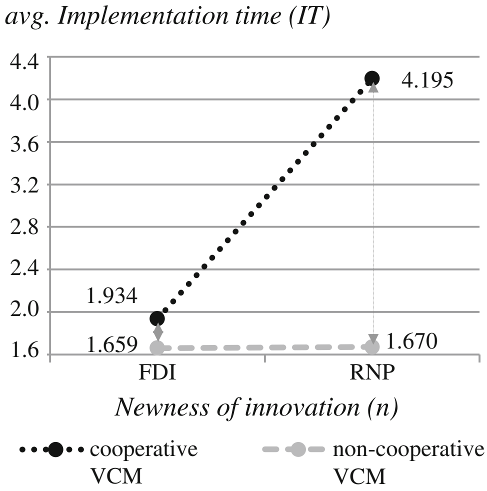
Interaction Between Newness of Innovation and VCM Strategy

Finally, the interaction effect between *n* and *m* on *IT* is calculated and is presented in Fig. 7.25. It is *1.125*. Alternative effect size measures here are: $\eta^2 = 0.100$; *partial* $\eta^2 = 0.128$; $\omega^2 = 0.100$. Following the effect size convention of Cohen (1977), the interaction effect between the newness of innovation (*n*) and the VCM strategy (*m*) on the implementation time (*IT*) is of medium size.

Result 6: The result indicates that the negative effect of the newness of innovation (*n*) on the implementation time (*IT*) is higher in the case of cooperative VCM. In fact, the newness of innovation has nearly no effect in the case of non-cooperative VCM. This result offers support for *H4*c.

The point to be made here is that really new products (RNPs) are implemented faster via non-cooperative VCM. This implies that non-cooperative VCM is more time-efficient when implementing RNPs. Both strategies lead to a similar implementation time when marketing functionality-driven innovations (FDIs). In these cases, the difference between cooperative and non-cooperative VCM is quite small. The speed of implementation in the case of cooperative VCM is reduced if supplier innovations also require changes in the manufacturing process. Moreover, supplier

Fig. 7.25 Interaction effect (n × m) on IT



innovations that only focus on the functionality aspect result in a lower preference for non-cooperative VCM.

An in-depth analysis exposes that there are 14,745 cases where *functionality-driven innovations* are implemented successfully. 7,883 cases are realized by pursuing cooperative VCM and 6,862 cases by pursuing non-cooperative VCM. Regarding *cooperative VCM*, 38.9 % of these 7,883 cases are implemented after one attempt, 77.1 % after two, 93.3 % after three, 98.1 % after four, and 99.4 % after five attempts. If the supplier selects *non-cooperative VCM*, he reduces the implementation time. This implies that 40.9 % of these 6,862 successful cases are realized after one attempt, 93.7 % after two, 99.5 % after three, 99.9 % after four, and 100.0 % after five attempts. The success rate of functionality-driven innovations increases exponentially. Remarkably, the curve of non-cooperative VCM attempts is characterized by a higher slope from the first to the second attempt (see Fig. 7.26). It implicates that learning has a stronger effect when implementing FDIs via non-cooperative VCM attempts because there is no manufacturer who tries to prevent it.

Moreover, the in-depth analysis shows that 6,615 cases represent *really new products* that are implemented successfully: 1,525 cases via cooperative and 5,090 cases via non-cooperative VCM. Successful *non-cooperative cases* of really new products have nearly the same values as cases of functionality-driven innovations. But successful *cooperative VCM cases* of really new products are characterized by different numbers of attempts: 15.3 % are implemented after one attempt, 31.7 % after two, 45.5 % after three, 59.9 % after four, 71.8 % after five attempts, etc. (see Fig. 7.27). In consequence, the success rate of really new products that are promoted via cooperative VCM runs linear. This implicates that manufacturers hamper really new products so heavily that learning cannot take effect. Therefore, suppliers

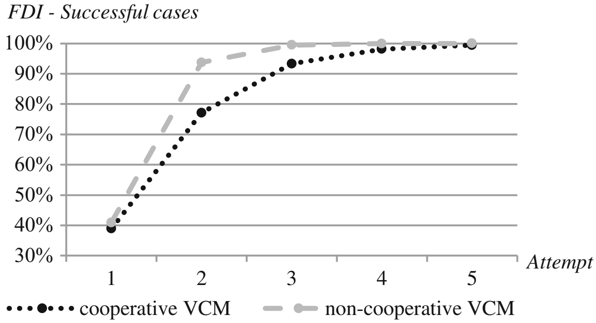


Fig. 7.26 Learning effect when implementing FDIs

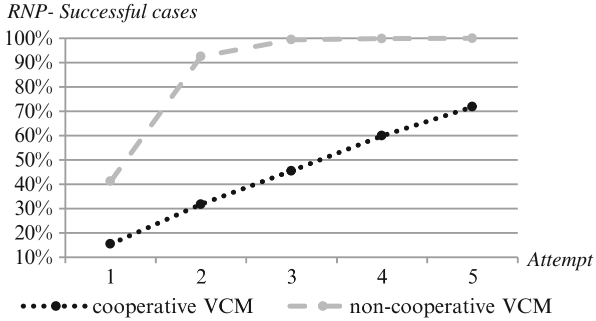


Fig. 7.27 Learning effect when implementing RNPs

cannot improve their innovation performance through learning when promoting RNPs via cooperative VCM.

7.8.2.2 Implementation Costs

After analyzing the effects on the response variable implementation time (*IT*), Table 7.22 displays the output of the "Tests of Between-Subjects Effects" for data set II when focusing on the response variable implementation costs (*IC*). As in the previous analysis, the factors VCM strategy (*m*) and newness of innovation (*n*) have significant effects and a 2-factor interaction effect is identified between the factors *n* and *m*.

Next, the effect matrix for the response variable *IC* is presented in Table 7.23 and contains two factor effects and the 2-factor interaction effect on implementation costs (*IC*).

VCM Strategy

As visualized in Fig. 7.28, the calculated effect size of the main effect *m* on *IC* is *1.425* Alternative effect size measures here are: $\eta^2 = 0.007$;

Table 7.22 ANOVA for main and interaction effect (data set II, response variable IC)

Source	Type III sum of squares	df	Mean square	F	Sig.
Main effect of *m*	7,220.037	1	7,220.037	170.672	0.000
Main effect of *n*	20,319.753	2	10,159.876	240.167	0.000
$m \times n$	2,171.188	1	2,171.188	51.324	0.000
Error	961,769.111	22,735	42.303		
Total	5,205,469.958	22,740			
Corrected total	1,013,167.928	22,739			

$R^2 = 0.052$ (adjusted $R^2 = 0.051$)

Table 7.23 Effect matrix (data set II, response variable IC)

	Factors	
Factors	*m*	*n*
m	1.425	−0.781
n		2.390

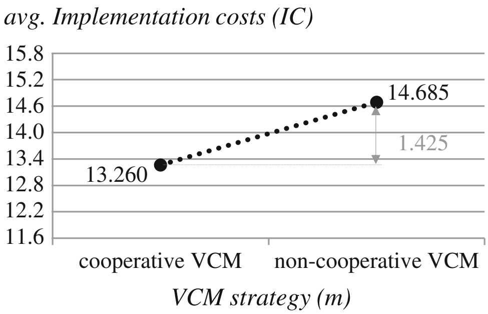


Fig. 7.28 Main effect VCM strategy (m) on implementation costs (IC)

partial $\eta^2 = 0.007; \omega^2 = 0.007$. Following the effect size convention of Cohen (1977), the VCM strategy (*m*) indicates a rather small but significant effect on the implementation costs (*IC*).

Result 7: Surprisingly, the usage of non-cooperative VCM results in higher implementation costs. This observation implies that suppliers have to invest more money to perform non-cooperative VCM successfully. In consequence, *H5a* has to be declined.

How smoothly the interaction or communication process between the involved value-chain actors runs heavily depends on their knowledge background. In the case of cooperative VCM, the supplier profits from the knowledge and expertise of the manufacturer. He has a present relationship with the respective applicator and thus knows his business very well. By cooperating with the manufacturer, the supplier is able to transmit a more appropriate message to the applicator. This, in turn, reduces the effort to convince the applicator and results in lower implementation costs. A detailed analysis of the cost elements in cooperative and

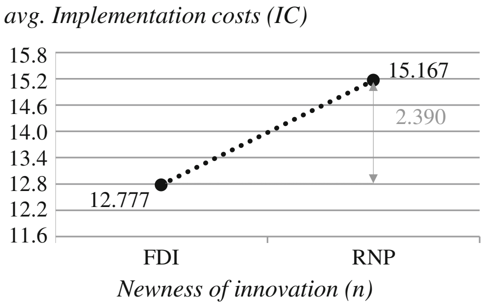


Fig. 7.29 Main effect newness of innovation (n) on implementation costs (IC)

non-cooperative VCM will be provided after presenting the interaction effect between the newness of innovation (n) and the VCM strategy (m).

Newness of Innovation

Following, the calculated effect size of the main effect n on IC is 2.390 and is illustrated in Fig. 7.29. Alternative effect size measures here are: $\eta^2 = 0.020$; *partial* $\eta^2 = 0.021; \omega^2 = 0.021$. Like the VCM strategy (m), the newness of innovation (n) has a rather small but significant effect on the implementation costs (IC).

Result 8: The analysis indicates that suppliers have to spend more money to implement really new products. In consequence, it is reasonable to argue that this type of innovation is too distant to the core business or competence of downstream customers. Based on this result, *H5b* is supported.

As stated before, suppliers must offer information on the product functionality as well as the process technology to implement really new products (RNPs). But it takes more effort to gather this kind of information as it is not a core competence of suppliers and applicators. This results in higher implementation costs. A close consideration of the different cost elements follows in the next paragraphs.

Interaction Between Newness of Innovation and VCM Strategy

Finally, the interaction effect between n and m on IC is calculated and is shown in Fig. 7.30. It is -0.781. Alternative effect size measures are: $\eta^2 = 0.002;$ *partial* $\eta^2 = 0.002; \omega^2 = 0.002$. Following the effect size convention of Cohen (1977), the interaction effect between the newness of innovation (n) and the VCM strategy (m) on the implementation costs (IC) is of small size.

Result 9: The result demonstrates that the impact of the newness of innovation (n) on the implementation costs (IC) is higher in the case of cooperative VCM. This result offers support for *H5c*.

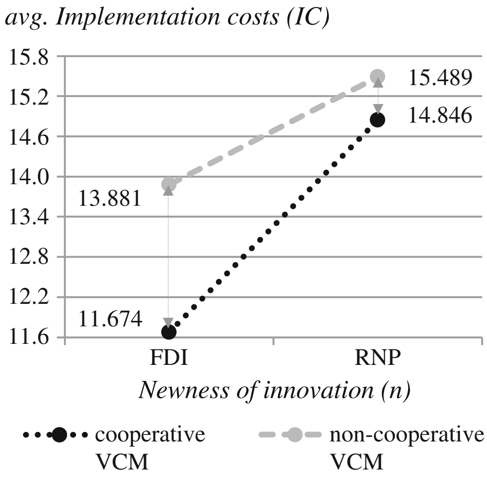


Fig. 7.30 Interaction effect (n × m) on IC

Both types of innovations functionality-driven innovations and really new products are implemented more cost-efficiently via cooperative VCM. This cost advantage of cooperative VCM is higher when marketing functionality-driven innovations. It decreases if the innovation also requires changes in the production process. This observation motivates a more detailed analysis of the different cost elements.

As mentioned before, suppliers who decide in favor of cooperative VCM often fail (in 84 % of the cases) to overcome the first threshold. The reason is that the manufacturer only supports the supplier's marketing attempt, if there is a perfect match of the marketing objectives (see Sect. 7.4.4). However, this step is not very cost intensive. It is often just a call and does not require big financial effort.

To clarify the cost advantage of cooperative VCM, the costs to take the second threshold "customer value" have to be analyzed in more detail. The first variable cost element in *cooperative VCM* is proportional to the difference of *joint M* and *EM*. As the manufacturer is able to improve the supplier's message, both can convey a more appropriate message to the final applicator. This lowers the difference of the supplier's and the applicator's message and thus the first variable cost element. The average message difference is 4.776 when marketing functionality-driven innovations and 4.038 when marketing really new products (see Fig. 7.31). The second variable cost element in cooperative VCM is proportional to the difference of CV_C and ECV_C. Here, the limitation $A_j \in \{2,3\}$ is less critical as the manufacturer can improve the amount of within-field knowledge. The customer value as perceived by the end applicator is contributed by both the supplier and the manufacturer. This lowers the difference of the customer values and thus the second variable cost element. The average difference of the customer values is 8.144 when marketing functionality-driven innovations and 8.884 when marketing really new products.

Suppliers who decide in favor of *non-cooperative VCM* pass the first threshold without big problems (in 65 % of the cases). The applicator only expects a partial

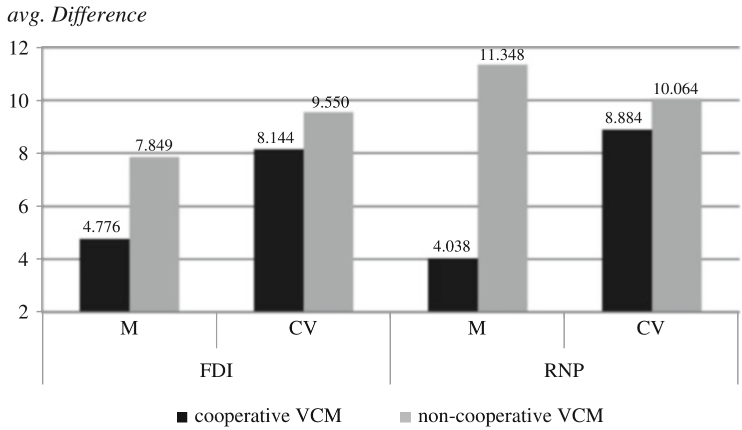


Fig. 7.31 In-depth analysis of the variable cost elements in VCM

match of the objectives. Consequently, this step is less critical than in the case of cooperative VCM. The first variable cost element is proportional to the difference of *M* and *EM*. As the supplier sends his message to the applicator without any help, the manufacturer cannot improve the supplier's message. As a result, a less appropriate message is conveyed, which in turn increases the first variable cost element. The average message difference is 7.849 when marketing functionality-driven innovations and 11.348 when marketing really new products. The second variable cost element in non-cooperative VCM is proportional to the difference between CV_{NC} and ECV_{NC}. Here, the limitation $A_j \in \{2,3\}$ is highly critical. The manufacturer does not improve the amount of knowledge. Thereby, the customer value as perceived by the applicator is only contributed by the supplier. This increases the difference of the customer values and thus the second variable cost element. The average difference of the customer values is 9.550 when marketing functionality-driven innovations and 10.064 when marketing really new products. Figure 7.31 summarizes the ideas of the last two paragraphs.

7.8.3 Analysis III: Effect of Knowledge Overlap

In contrast to the first analysis, analysis III focuses on the knowledge overlap between the involved value-chain actors instead of the newness of innovation. To analyze the impact of knowledge overlap (o) on marketing success (S), the third data set includes every single step or run within a supplier's marketing attempt. An example: The supplier 79 tries to implement his functionality-driven innovation (FDI) via cooperative VCM (c-VCM). After four attempts he implements it successfully (see Fig. 7.32). These four attempts are included in the third data analysis.

	ID Supplier	VCM strategy (m)	Newness of innovation (n)	ID Manu-facturer	ID Applicator	Knolwedge overlap (o)	Marketing success (S)	
Attempt 1	79	c-VCM	FDI	6	42	+++	0	**Analysis III**
Attempt 2	79	c-VCM	FDI	31	41	+++	0	
Attempt 3	79	c-VCM	FDI	15	63	+++	0	
Attempt 4	79	c-VCM	FDI	0	56	+++	1	**Analysis I**

Fig. 7.32 The relevant data included in the third analysis

Table 7.24 Design matrix (data set III)

Design point	Factors			Response
	m	n	o	S
1	c-VCM	PDI	+	0.000
2	c-VCM	PDI	++	0.000
3	c-VCM	PDI	+++	0.000
4	c-VCM	FDI	+	0.000
5	c-VCM	FDI	++	0.162
6	c-VCM	FDI	+++	0.355
7	c-VCM	RNP	+	0.000
8	c-VCM	RNP	++	0.051
9	c-VCM	RNP	+++	0.015
10	nc-VCM	PDI	+	0.120
11	nc-VCM	PDI	++	0.082
12	nc-VCM	PDI	+++	0.024
13	nc-VCM	FDI	+	0.347
14	nc-VCM	FDI	++	0.391
15	nc-VCM	FDI	+++	0.359
16	nc-VCM	RNP	+	0.280
17	nc-VCM	RNP	++	0.326
18	nc-VCM	RNP	+++	0.339

Table 7.24 presents the design matrix of data set III with over 2,560 simulation runs. As in the first data set, the value S_i is calculated as the average result of a supplier's marketing attempt for each run i. The design matrix is expanded by the knowledge overlap between the involved actors (o). In total, there are 18 design points or VCM settings. As a reminder, the factor VCM strategy (m) comprises two levels: cooperative (c-VCM) and non-cooperative VCM (nc-VCM). The factor newness of innovation (n) has three levels: process-driven innovation (PDI), functionality-driven innovation (FDI), and really new product (RNP). The factor knowledge overlap (o) consists of three levels: small overlap (+), medium overlap (++), and high overlap (+++).

The output of the "Tests of Between-Subjects Effects" for data set III is summarized in Table 7.25. All factors have significant effects. Moreover, significant 2-factor interaction effects are identified. The following analysis focuses on the main effect of knowledge overlap (o) and the interaction effect between knowledge overlap (o) and VCM strategy (m) on marketing success (S).

Table 7.25 ANOVA for main and interaction effect (data set III)

Source	Type III sum of squares	df	Mean square	F	Sig.
Main effect of *m*	15.998	1	15.998	187.378	0.000
Main effect of *n*	13.704	2	6.852	80.259	0.000
Main effect of *o*	5.354	2	2.677	31.335	0.000
$m \times n$	4.824	2	2.412	28.250	0.000
$m \times o$	42.328	2	21.164	247.893	0.000
$n \times o$	57.526	4	14.381	168.449	0.000
$m \times n \times o$	79.975	4	19.994	234.187	0.000
Error	15,373.098	180,064	0.085		
Total	22,392,000	180,082			
Corrected total	19,607.704	180,081			

$R^2 = 0.216$ (adjusted $R^2 = 0.216$)

Table 7.26 Effect matrix (data set III)

	Factors	
Factors	*m*	*o*
m	0.187	−0.066 [−0.027; −0.039]
o		0.057 [0.044; 0.013]

Next, the effect matrix shows the factor effects and the 2-factor interaction effect on *S* (see Table 7.26). As in the first data set, the factors in the third data set are characterized by a different number of levels. Factor *m* is characterized by two attribute levels (cooperative and non-cooperative VCM) and factor *o* has three attribute levels. Consequently, the effect size of the main effect *o* on *S* and the interaction effect between *o* and *m* on *S* is divided into three values: from small knowledge overlap (+) to medium knowledge overlap (++), from medium knowledge overlap (++) to high knowledge overlap (+++), and from small knowledge overlap (+) to high knowledge overlap (+++). The first and the second value are listed in squared brackets.

7.8.3.1 Knowledge Overlap

As depicted in Fig. 7.33, the calculated effect size of the main effect *o* on *S* is *0.057* [*0.044*; *0.013*]. Alternative effect size measures are: $\eta^2 = 0.0003$; *partial* $\eta^2 = 0.0003$; $\omega^2 = 0.0003$. Following the effect size convention of Cohen (1977), the knowledge overlap (*o*) indicates a very small but significant effect on the marketing success (*S*).

Result 10: The data demonstrate that the overlap between the firms' knowledge bases has a slight positive effect on the marketing effectiveness of a supplier's attempt to implement his present innovation. In consequence, this result offers weak support for *H6*.

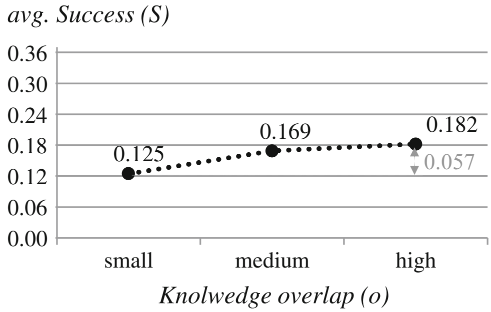


Fig. 7.33 Main effect knowledge overlap (o) on marketing success (S)

As indicated in Sect. 3.3.3, the more closely the involved value-chain actors overlap in their knowledge bases, the smoother the communication or interaction process and the higher the success rate of supplier innovations. Regarding the case studies, a high overlap requires that the involved actors share knowledge in the chemical, technical, and application-related fields. In Case 1, for example, the supplier focuses on the chemical field. But he reduces the distance to the applicator by having experts in his own ranks who specialize in the functionality of final products, application trends, and regulations. The applicator, in turn, has employees with a university degree in chemistry and work experience in the field of manufacturing. In this manner, the differences between the communication worlds are minimized and the implementation of the supplier innovation is fostered.

7.8.3.2 Interaction Between Knowledge Overlap and VCM Strategy

To study if there is a difference between cooperative and non-cooperative VCM, the interaction effect between the overlap (o) and the VCM strategy (m) on the marketing success (S) is calculated (see Fig. 7.34). Here, it is -0.066 [-0.027; -0.039]. Alternative effect size measures are: $\eta^2 = 0.002$; *partial* $\eta^2 = 0.003$; $\omega^2 = 0.002$. Compared with the main effect, the interaction effect is stronger in its impact.

Result 11: The data indicate that the effect of knowledge overlap on marketing success is higher in the case of cooperative VCM. In consequence, *H7* is supported.

More precisely, there is a positive, monotonic relationship if the supplier pursues *cooperative VCM*. The more closely the joint knowledge base of the supplier and the manufacturer overlaps with that of the end applicator, the smoother the communication and the higher the average marketing success will be.

Surprisingly, the data demonstrate a nonmonotonic or inverted U-shaped relationship if VCM is done *non-cooperatively*. This implies that the average marketing success will increase with increasing overlap between the knowledge bases of the supplier and the applicator. But beyond some optimum the average marketing

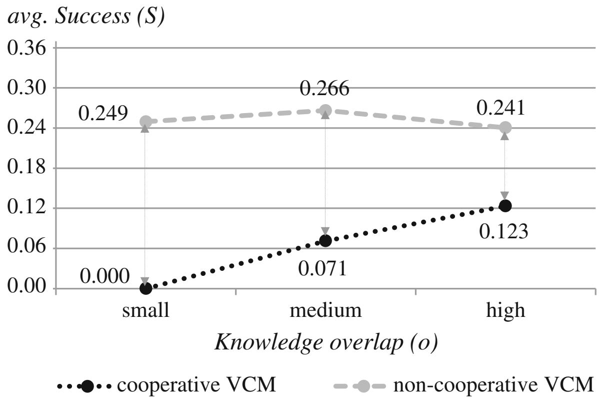


Fig. 7.34 Interaction effect (o × m) on S

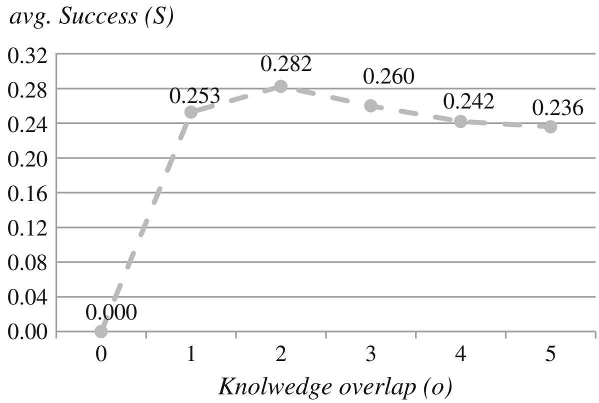


Fig. 7.35 Effect of knowledge overlap in non-cooperative VCM attempts

success will decrease with increasing knowledge overlap. This observation motivates a more detailed analysis of non-cooperative VCM attempts.

As depicted in Fig. 7.35, the optimum is observed if the supplier and the applicator have two knowledge fields in common.

Now the question arises which knowledge fields the supplier and the applicator should share to finally implement a supplier innovation. The analysis shows that the supplier and the applicator should overlap in the *Ks* that are available in the supplier's marketing concept (MC^S) and thus refer to the type of innovation (see Sect. 7.4.2). In fact, these two knowledge fields are critical to implement a supplier innovation. An example is shown in Fig. 7.36.

As a reminder, the supplier offers a *process-driven innovation* if both *Ks* range from 3 to 4. In these cases, the applicator should be knowledgeable about *K* 3 and 4 to successfully implement the innovation. If both *Ks* range from 5 to 6, the supplier tries to implement a *functionality-driven innovation*. Here, the applicator should have knowledge in *K* 5 and 6 (cf. Fig. 7.36). If one of the *Ks* is within 3–4 and the other *K* is within 5 to 6, the supplier provides a really new product.

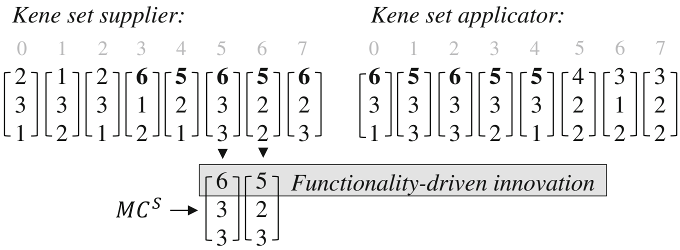


Fig. 7.36 Example of knowledge overlap in the fields defining the innovation type

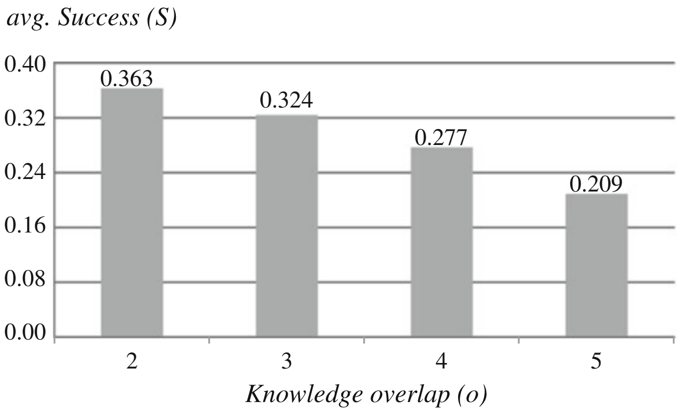


Fig. 7.37 Effect of knowledge overlap in the critical fields

To implement this kind of innovation successfully, the supplier and the applicator must overlap in *K* 3 or 4 and 5 or 6.

If the knowledge fields in common equal the fields that describe the supplier innovation (see Fig. 7.36), the average success rate is 0.363. This rate decreases if the actors overlap in more than the two relevant fields: 0.324 if they overlap in one additional field, 0.277 if they overlap in two additional fields, and 0.209 if they overlap in three additional fields. The results are summarized in Fig. 7.37.

In sum, the results of the third analysis suggest that *cooperative VCM* offers a better performance if there is a quantitative overlap, i.e. an overlap in as many knowledge fields as possible. Here, the applicator expects a smooth communication. He takes the view that the integrated manufacturer should have high expertise in communicating with the downstream stage because it is his daily business. Thus, a high overlap between the knowledge bases of the involved interlocutors is essential. A way for suppliers to offer a high overlap is to look for a partner who has a totally different knowledge base. As discussed by Ahrweiler et al. (2004), this partner search strategy is called progressive strategy.

In *non-cooperative VCM*, a qualitative overlap, i.e. an overlap in the relevant or critical knowledge fields, results in higher marketing effectiveness. This is based on the fact that the applicator primarily expects innovative ideas of the supplier. A high knowledge overlap is thus not essential in non-cooperative VCM attempts.

7.9 Discussion and Validation of Results

The next section fulfills two purposes. First, it briefly restates and discusses the results of the agent-based simulation study. Next, it includes the attempt to validate the simulation model's results.

In the agent-based simulation study, the basic concept is to model the acceptance and implementation of supplier innovations by first describing simple rules of behavior for the different types of agents and then aggregating these rules. In particular, the case study results are used to set the agents' rules of behavior. The general aim is to study and assess a multiplicity of VCM settings while looking at the reactions they provoke in population. The simulation study helps to empirically test the validity of case study patterns and to identify additional patterns in the use of cooperative and non-cooperative VCM. It permits to refine, test, and verify theories that have been previously developed by multiple case studies. However, the special aim is to analyze the interaction effects between the newness of innovation, the VCM strategy, and the knowledge overlap on the performance of a supplier's marketing attempt.

7.9.1 Analysis I: Marketing Success or Effectiveness

To compare the marketing success of cooperative and non-cooperative VCM, all successful and failed marketing attempts of suppliers are included. The analysis of data set I suggests that the VCM strategy has an impact on the marketing effectiveness of a supplier's attempt to promote and implement an innovation. In contrast to cooperative VCM, non-cooperative VCM is the more effective strategy. Furthermore, a strong negative impact of the newness of innovation on the marketing effectiveness is found. Therefore, the more the supplier innovation focuses on the functionality, the higher the marketing success.

The results also show that the impact of the newness of innovation on the effectiveness is higher in cooperative VCM attempts. Consequently, cooperative VCM is the more sensitive and more restrictive strategy. The success of this VCM strategy is highly influenced by the newness of innovation. In some detail, process-driven innovations as well as really new products are implemented more effectively via non-cooperative VCM. Both VCM strategies lead to a similar success rate when marketing functionality-driven innovations, but with a slight preference for cooperative VCM. The in-depth analysis of the interaction effect between the newness of innovation and the strategy indicates that non-cooperative VCM is more effective to overcome the first threshold "match of marketing objectives", whereas cooperative VCM offers advantages to overcome the second threshold "match of customer values".

To pass these thresholds more easily in the future, suppliers must spend more time to analyze the value chain in which they operate (see Sect. 2.3.2). This is essential to gain a deep and complete understanding of the value chain, its (downstream) players, and their marketing objectives. If suppliers are well-informed on applicators' objectives, manufacturers must support suppliers' attempts more often as the first threshold is passed in more cases. In addition, suppliers can foster the proactive dialogue with downstream customers and learn more about their expectations. In this way, suppliers are able to transfer more valuable information and thus offer a higher customer value to the respective applicator. In other words, they overcome the threshold "match of customer values" more easily.

Another important point is that suppliers who proactively interact with applicators can evoke applicators' interest for innovations that require changes in the production process, i.e. process-driven innovations (PDIs) and really new product (RNPs). This is based on the fact that applicators will learn to assess the advantages of PDIs and RNPs by regularly communicating with suppliers. To summarize, the success of suppliers to implement their present innovations is based on the analysis of the respective value chain.

7.9.2 Analysis II: Marketing Efficiency (Implementation Time and Costs)

To compare the marketing efficiency, i.e. the time and money required to implement a supplier innovation via cooperative or non-cooperative VCM, all successful marketing attempts of suppliers are included. The analysis of the second data set indicates three different findings. The *first finding* is that the VCM strategy strongly impacts the efficiency of a supplier's marketing attempt. This clear effect is divided into the effect on implementation time and the effect on implementation costs. On the one hand, suppliers speed up the implementation of their innovations by pursuing non-cooperative VCM. On the other hand, supplier innovations are implemented more cost-efficiently via cooperative VCM.

The *second finding* is that the newness of innovation impacts the marketing efficiency. The more the supplier innovation focuses on the functionality, the higher the efficiency of a supplier's marketing attempt. More precisely, functionality-driven innovations are implemented faster and more cost-efficiently than really new products. This kind of innovations is proactively in demand by applicators and close to their core business (i.e. product functionality). Really new products are demanded rarely by applicators. They provide a new product functionality in combination with a new process technology. As the domain of processes is not a core competence of applicators, suppliers have to invest more time and money in collecting relevant information and explaining it. In other words, the explanation of new processes requires specialized knowledge in more distant fields that is spread on different people. This implies that suppliers can spend less time and money to present the central feature, i.e. the product functionality. In consequence, suppliers have much more difficulty convincing the applicator to accept really new products.

The *third finding* is that the impact of newness of innovation on the efficiency is higher in the case of cooperative VCM. This again points out that cooperative VCM is the more sensitive strategy as its efficiency highly depends on the newness of innovation. The interaction effect is also separated into the effect on implementation time and the effect on implementation costs. With respect to *time*, the impact of the newness of innovation is higher in the case of cooperative VCM. Actually, the newness of innovation has nearly no effect in non-cooperative VCM attempts. The results demonstrate that non-cooperative VCM is more time-efficient when implementing really new products. Both strategies lead to a similar implementation time when marketing functionality-driven innovations. The speed of implementation of cooperative VCM attempts is reduced if innovations also require changes in the process technology.

With respect to *costs*, the impact of the newness of innovation on implementation costs is higher in the case of cooperative VCM. But there is also an effect when pursuing non-cooperative VCM. In a nutshell, functionality-driven innovations and really new products are implemented more cost-efficiently via cooperative VCM. This cost advantage is higher when implementing innovations that focus on the product functionality. It decreases if the said innovation also requires changes in the process technology. In total, cooperative VCM is the more sensitive and restrictive VCM strategy. The efficiency of this strategy is highly influenced by the newness of innovation.

The results of the *in-depth analysis* demonstrate that suppliers who decide in favor of *cooperative VCM* often fail to pass the threshold "match of marketing objectives". This is based on the fact that manufacturers hamper all kinds of innovations that are not proactively in demand by applicators. The point to be made here is that this step only evokes a low and fixed amount of costs. It is just a call and does not require big financial effort. The first variable cost element in cooperative VCM is the cost to target an applicator. The supplier cooperates with a manufacturer and both transmit a joint message. This cost element is proportional to the difference of the joint message (*joint M*) and the applicator's message (*EM*). As the manufacturer helps to improve the supplier's message, both actors can convey a more appropriate message to the applicator. In other words, the difference between *joint M* and *EM* is relatively small. This results in lower implementation costs. The second variable cost element is proportional to the difference between the customer value the supplier and the manufacturer offer (CV_C) and the value the applicator expects (ECV_C). The limitation $A_j \in \{2,3\}$ is less critical here because the manufacturer helps to improve the amount of knowledge. In other words, the difference between CV_C and ECV_C is relatively small. This again lowers the implementation costs. A graphical representation is shown in Fig. 7.38.

In contrast, suppliers who decide in favor of a *non-cooperative VCM strategy* pass the first threshold without big problems. The applicator just expects a partial

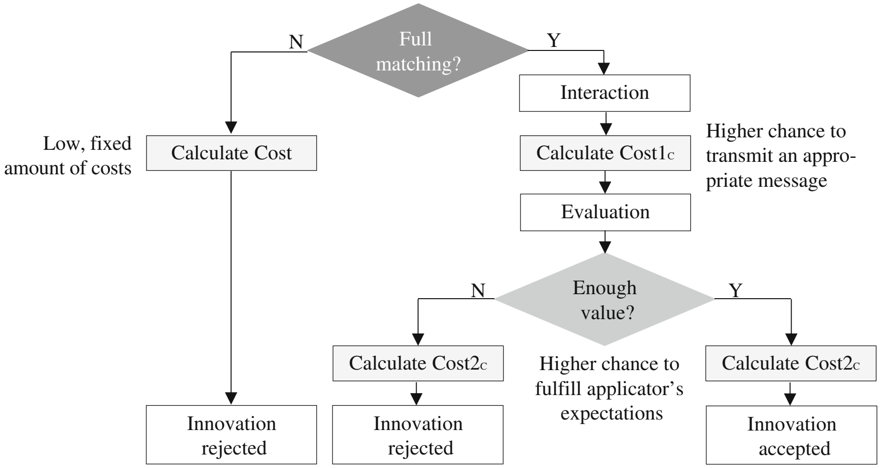


Fig. 7.38 Cost elements in cooperative VCM

instead of a full matching. Therefore, he also accepts innovations for which he does not formulate an urgent need. In consequence, the step "match of marketing objectives" is less critical here than in the case of cooperative VCM. The first variable cost element is proportional to the difference of the supplier's message (*M*) and the applicator's message (*EM*). As the supplier sends his message to the applicator without any help, the manufacturer does not help to improve the supplier's message. Consequently, a less appropriate message is conveyed, which in turn increases the implementation costs due to the relatively high difference between *M* and *EM*. The second variable cost element is proportional to the difference between the customer value the supplier offers (CV_{NC}) and the value the applicator expects (ECV_{NC}). The limitation $A_j \in \{2,3\}$ is very critical as the manufacturer does not improve the amount of knowledge. Thereby, the customer value as perceived by the applicator is only contributed by the supplier. As a result, the implementation costs increase due to the relatively high difference between CV_{NC} and ECV_{NC}. These ideas are summarized in Fig. 7.39.

In sum, suppliers have to invest more time to perform cooperative VCM successfully (1.7 attempts vs. 3.1 attempts). On the other hand, they have to spend less money to implement their innovations via cooperative VCM (13.3 vs. 14.7 total costs).

In order to spend less money when using non-cooperative VCM in the future, suppliers should try to transmit a more appropriate message and clearly demonstrate the customer value of the present innovation to the applicator. To do so, suppliers can take different actions (see Sect. 2.3.3). A supplier's product strategy is one critical element. Presenting the innovative product to the applicator includes a message that defines the use of the product, its features, advantages compared to competitors, benefits for applicators, the brand, and value-added services. A creative solution to present the use of a product is to develop a product form which

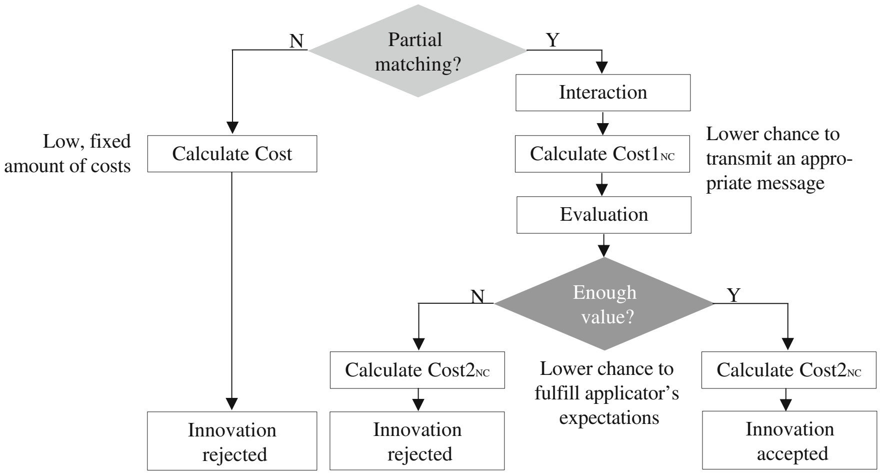


Fig. 7.39 Cost elements in non-cooperative VCM

allows the supplier to leapfrog the manufacturer. An example: In Case 5, the supplier offers granulates which already contain all critical product characteristics. Moreover, suppliers can customize the name of the product which should express the benefit for applicators. To connect the physical product with the needs of applicators, supplier firms can offer value-added services like trainings and workshops. The supplier in Case 1 initiates customer days with applicators to take the advantage of a relaxed atmosphere. This will also help to strengthen and emotionalize the customer relationship. Another marketing instrument suppliers can take is to quote their prices in adjusted units used by applicators to increase the success of their innovative products (see Case 2 and 5). By establishing personal and regular updates on market trends and occasional visits, suppliers build trust, sympathy, as well as improve their knowledge and expertise through learning and adaptation.

7.9.3 *Analysis III: Effect of Knowledge Overlap*

In contrast to the first analysis, the aim of the third analysis is to focus on the knowledge overlap between the involved value-chain actors. To study the impact of knowledge overlap on marketing success, the third data set includes every single step or run within a supplier's marketing attempt. First, the analysis of data set III suggests that knowledge overlap has a slight positive effect on the marketing effectiveness or success.

Second, the data demonstrate that the effect of knowledge overlap on marketing effectiveness is higher in the case of cooperative VCM. This implicates that non-cooperative VCM is the more robust VCM strategy as its success rate depends less on the overlap between the involved actors. More to the point, there is a positive, monotonic relationship in the case of *cooperative VCM*. It implies that the more closely the joint knowledge base of the supplier and the manufacturer overlaps with that of the applicator, the smoother the communication and the higher the average success will be. In other words, a cooperative VCM strategy offers a better performance if there is a quantitative overlap, i.e. an overlap in as many knowledge fields as possible. When confronted with cooperative VCM, applicators expect a smooth communication and thus a high overlap between the knowledge bases of the involved interlocutors. They take the view that the integrated manufacturer should have much experience in communicating with the downstream stage because it is his daily business.

In the case of *non-cooperative VCM*, there is a nonmonotonic or inverted U-shaped relationship. This implicates that the average success increases with increasing overlap between the knowledge bases of the supplier and the applicator. But beyond some optimum the success will decrease with increasing overlap. This optimum is observed if the supplier and the applicator overlap in two knowledge fields. In consequence, a qualitative overlap, i.e. an overlap in the two relevant or critical knowledge fields, results in higher marketing effectiveness when using non-cooperative VCM. The applicator primarily expects innovative ideas of the supplier. A high knowledge overlap is thus not essential.

The *in-depth analysis of non-cooperative VCM* suggests that the two critical fields frequently equal the fields used in a supplier's marketing concept. These two fields describe the features of the respective innovation. If the supplier and the applicator overlap in more than the two critical fields, the success rate decreases. This implicates that an overlap in additional fields only takes the attention away from the main topic of interest.

In order to increase the success rate of non-cooperative attempts in the future, suppliers should try to primarily cover the critical or relevant knowledge fields. To do so, they have to build effective training for the largest possible number of employees in order to equip them with the critical knowledge (see Sect. 2.3.4). Regarding the five cases, all suppliers initiate a task force or business unit that enables them to embrace applicators and become familiar with their business process and the industry developments. Recruiting external persons like executives from customer industries could also be an option to gain access to critical information and reveal downstream customer needs.

7.9.4 Nuisance Factors

Besides the analyzed factors, there are nuisance factors which exist within the simulation experiment. These factors are not relevant for the researcher but they have an impact on the simulation outcome (Lorscheid et al. 2012). Nuisance factors can be controllable, uncontrollable, or even unknown (see Montgomery 2009). Controllable nuisance factors are known as control variables such as innovation rate and big supplier's ratio. These factors are tested in a sensitivity analysis and are fixed to a value (Lorscheid et al. 2012). Uncontrollable nuisance factors are the result of stochastic process elements such as random selection. In this simulation model, there are several random selection processes, e.g. the selection of the agents' *Ks*, *As*, and *Es* in order to create a model that is close to the real-world system. In consequence, uncontrollable or unknown nuisance factors cause random variability in the simulation results and are called noise, experimental variation, or experimental error (Box et al. 2005). This could distort the analysis of outcome differences between simulation settings (Lorscheid et al. 2012). In order to obtain meaningful results, the mean and the variance over several simulation runs per setting were analyzed in Sect. 7.7 (estimation of error variance).

7.9.5 Validation

After restating and discussing the simulation model's results, they have to be validated. As discussed by Gilbert (2008), validation describes the correspondence between simulation model and target system, i.e. whether the simulation model represents the target's behavior correctly. In other words, the simulation model should be "an accurate representation of the actual system being studied" (Law 2007, p. 243).

In the ABM literature, a distinction is made between empirical calibration or micro-validation and empirical validation or macro-validation (see e.g. Fagiolo et al. 2007; Boero and Squazzoni 2005). As stated in Sect. 7.4, the model developed in this thesis is empirically calibrated by using a history-friendly approach (see Fagiolo et al. 2006). This approach implies that the case studies in the coatings and sealants industry presented in Chap. 6 are used to guide the modeling of parameters, agent interactions, and agent decision rules (see Garcia et al. 2007). To empirically validate a model, the simulation outputs have to be confronted with an independent set of empirical data (e.g. long time series of individual and group data). But the input and output parameters in this model do not coincide with empirical data. Therefore, several techniques suggested by Law (2007) and Sargent (2005) are used to approximate validation.

- *Using existing theory or studies:* The VCM model is based on the literature in the field of marketing and innovation (see Chaps. 2 and 3), the pilot and case study (see Chaps. 5 and 6), as well as the SKIN model (see Chap. 7).
- *Modeler experience and intuition:* The modeler acquires broad knowledge of the domain of marketing research. This guides the development of the VCM model and the experimentation.
- *Sensitivity analysis/parameter variability:* To successfully overcome the case-specific dilemma of history-friendly models, a sensitivity analysis is performed in Chap. 7 (cf. Eliasson and Taymaz 2000).

- *Conversations with subject-matter experts during development/face validity:* The VCM model is built with qualified and experienced advisers. To get feedback, it is presented several times to a group of scientists dealing with ABM.
- *Internal validity:* To get stable results, many simulation runs of one VCM setting or experimental condition are performed.
- *Observing macro-level effects:* To check whether theory assumptions hold on the macro level, simulation data are gathered via experimentation.
- *Discuss model output with subject-matter experts and users/face validity:* The results are discussed with the said researchers to argue their validity.

A next important step should include publishing and presenting the entire VCM model to suppliers of entering goods. This would establish possibilities to critically reflect the model's technical architecture as well as its substance. Furthermore, by making the model public to industry participants, its practical value could be tested and evaluated. The feedback of supplier firms will help to further improve the VCM model.

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Part V
Integrating Findings

Chapter 8
Discussion of Findings

In the following chapter, the central findings of the theoretical foundation (cf. Chaps. 2 and 3) and the empirical analysis (cf. Chaps. 5, 6 and 7) are summarized and conclusively discussed. Thereafter, this chapter points the reader's attention to the important limitations of the present study.

8.1 Summary of Findings

This doctoral project began with an investigation of a big problem suppliers of entering goods are confronted with when marketing their innovations. They usually approach the value chain by dealing with their immediate customers and essentially pushing their innovations into a value chain. Based on the fear to place their relationships with immediate customers at risk, suppliers do not consider other marketing approaches than push marketing. But immediate customers have low incentives to adopt supplier innovations. The value associated with a supplier innovation is not always evident for immediate customers and becomes more obvious when entering goods get closer to their final application. Therefore, immediate customers mostly estimate the investments required to implement supplier innovations and prefer to wait until they receive strong signals from their downstream customers indicating the need for an innovation. To break through immediate customers' resistance of innovation, suppliers rely more and more on Value Chain Marketing (VCM) by enlarging their target group beyond their immediate customers and addressing their downstream customers as well. In the extant literature, the marketing problems of suppliers are largely ignored. Therefore, a research gap is stated and poses the general research proposition of this thesis: a supplier's marketing attempt to implement an innovation along the value chain via VCM is closely tied to his marketing result.

To explore the research proposition, the study deals at first with the central terms value chain and derived demand before introducing the relevant marketing

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strategies for dealing with derived demand, i.e. push marketing, pull marketing, and VCM. Afterward, VCM is connected with the marketing of innovation. In this context, special attention is given to the challenges suppliers are faced with when marketing their innovations. The knowledge gained in the theoretical part is used to conceptualize a framework for exploring the VCM phenomenon in detail. Next, the general research proposition is specified and structured in three analytical studies.

Pilot study:

- *Research aim:* Exploring the importance of VCM in different industrial value chains and understanding the general VCM process.
- *Research questions:* In which applications is VCM a relevant and widely used marketing strategy? How are the value chain and the VCM process designed?

Case study:

- *Research aim:* Investigating the strategic approaches to VCM and identifying the factors that influence the marketing effectiveness of these approaches.
- *Research questions:* Which strategic approaches to VCM are pursued? What characterizes them? Which factors have an impact on the marketing effectiveness of the identified approaches?

Simulation study:

- *Research aim:* Studying the impact of the identified factors for the supplier's marketing performance systematically.
- *Research questions:* How does the marketing performance differ across the VCM strategies? How do the identified factors influence the supplier's marketing performance? How do the identified factors interact?

The results of the first study (i.e. the pilot study) confirm the high relevance of VCM in the coating industry, especially in the OEM finishing as well as the textile and packaging coating. VCM is described as a promising strategy to increase the success of supplier innovations. This study further provides an insight into the structure of different application value chains and levels up the understanding of the general VCM process. The nature of this process depends on the timing of integrating the immediate customer. Suppliers pursuing VCM either integrate the manufacturer at the beginning or at a later stage of the process. Based on the results of the pilot study, the conceptual framework is refined, the field of research is expanded by the sealant industry, and two research propositions referring to VCM and its marketing effectiveness are posed.

The results of the second study (i.e. the case study) validate the existence of two VCM strategies: cooperative and non-cooperative VCM. Cooperative VCM is characterized by an early integration of the manufacturer and requires his active participation in the VCM process. By contrast, non-cooperative VCM equals the description of the autonomous approach where the manufacturer only takes a passive part in the process. As already stated in the pilot study, the case studies confirm that there is a preference for non-cooperative VCM. The results further suggest that the newness of innovation and the knowledge overlap between the involved actors enable or inhibit the implementation of supplier innovations via cooperative or non-cooperative VCM. In consequence, both research propositions are supported by the second qualitative study. The analysis of the cases also discloses that the newness of innovation and the knowledge overlap are somehow interrelated. Based on the case study results, research hypotheses are developed and tested in the simulation study afterward.

The third study (i.e. the agent-based simulation study) permits a detailed evaluation of the impact of the identified factors on the supplier's marketing performance. First, the results support the hypothesized relationship between VCM strategy and marketing performance, which is divided into marketing efficiency and effectiveness. On the topic of marketing efficiency, suppliers speed up the implementation of their innovative products by pursuing non-cooperative VCM because they profit from a strong learning effect. With each non-cooperative VCM attempt, they become more practiced and more efficient at interacting with downstream customers. Conversely, suppliers implement their innovations more cost-efficiently via cooperative VCM. This is based on the low amount of related variable costs when pursuing cooperative VCM. Here, suppliers profit from manufacturers' knowledge and expertise to interact with applicators. For that reason, more appropriate messages and higher customer values are offered to applicators. On the topic of marketing effectiveness, the results support the hypothesis that non-cooperative VCM is the more effective marketing strategy as it leads to a higher success rate. The reason behind is the openness of applicators to supplier innovations because they are continually searching for opportunities to maintain sustainable competitive advantage.

Second, the results confirm that marketing performance is directly related to the newness of innovation. This implies that the more the innovation focuses on the functionality aspect, the more efficient a supplier's marketing attempt. More to the point, functionality-driven innovations are implemented more time-efficiently and less cost-intensively than really new products. This can be explained by the knowledge or information required to present both a new functionality and a new process when marketing really new products. Functionality-driven innovations are also characterized by a higher average success rate. This kind of innovations is proactively demanded by applicators in order to correspond to current and future needs of consumers.

Besides the presented main effects, different interactions effects between the newness of innovation and the VCM strategy are tested. When using non-cooperative VCM, the newness of innovation does not affect the implementation time. But it increases the number of attempts needed for cooperative VCM because the supplier often fails to overcome the threshold "match of marketing objectives". This is based on the fact that manufacturers try to hamper supplier innovations so heavily that learning cannot take effect. As a result, suppliers are hindered to improve their innovation performance through learning and adaptation. With respect to costs, the results indicate that the impact of the newness of innovation is higher in the case of cooperative VCM. In a nutshell, functionality-driven innovations and really new products are implemented more cost-efficiently via cooperative VCM. This is based on the manufacturers' support that reduces the distance to the applicator and thereby the total implementation costs. Still, the cost advantage of cooperative VCM decreases if the supplier tries to implement an innovation that also requires changes in the process technology. The simulation results further suggest that the newness of innovation has a stronger impact on the average marketing success of cooperative VCM. In fact, both strategies lead to a similar success rate when marketing functionality-driven innovations. However, the success rate of cooperative VCM attempts decreases if suppliers also try to implement a new process.

Third, the results indicate that the marketing effectiveness is significantly affected by the knowledge overlap. Still, the influence of this impact is not uniform. The direction depends on the selected VCM strategy. When using cooperative VCM, a high knowledge overlap benefits the effectiveness of a supplier's marketing attempt. This implicates that the more closely the knowledge base of the supplier and the manufacturer overlaps with that of the applicator, the higher the average marketing success. The reason behind is that applicators expect an effective communication if they are confronted with cooperative VCM. They take the view that the integrated manufacturers should have much experience in communicating with the downstream stage because it is their daily business. Conversely, a nonmonotonic or inverted U-shaped relationship is observed if suppliers pursue non-cooperative VCM. Instead of a quantitative overlap, an overlap in the critical knowledge fields that are used in a supplier's marketing concept and thus describe the supplier innovation in question results in a higher effectiveness. This can be explained by the fact that an overlap in additional fields only takes the attention away from the main topic of interest when marketing supplier innovations via non-cooperative VCM.

With the help of the simulation study, the qualitative results of the pilot and case study could be supported. But the main benefit of the simulation is to refine the previous results and focus on the interaction effects. Based on the simulation results, the newness of innovation has the strongest impact on marketing performance, followed by the VCM strategy. The knowledge overlap is deemed least important but also shows a significant impact on the effectiveness of a supplier's marketing attempt. The analysis of the interaction effects indicates that cooperative VCM is the more sensitive or less robust strategy, i.e. the newness of innovation and the knowledge overlap need to be considered more carefully. In other words, the performance of cooperative VCM is highly influenced by the newness of innovation and the knowledge overlap.

8.2 Scope of Generalization and Limitations

In order to minimize the limitations, the present work uses three different methods, namely a pilot study, a case study, and a simulation study. As stated in Sect. 4.2, the effective use of multiple methods helps to explain variance which would otherwise be neglected by mono-method studies (Jick 1979). This way, conclusions can be drawn more easily and thereby validity is increased. Greene et al. (1989) aptly summarize that mixed methods add breadth and scope to a research project. Based on the pilot study results, research propositions are developed and tested in the second step by conducting multiple case studies. The agent-based simulation study, in turn, tries to remedy the deficiencies of the case study research: First, it lacks in external validity or generalizability. Second, its sample is unbalanced. Third, the firms in the case study sample obviously do not represent all firms in their respective industries, and the selected projects clearly do not represent all VCM projects. Fourth, the process by which the cases are selected may introduce some bias to the findings.

Overall, a combination of the three research methods improves the robustness and generalizability of the findings as it guarantees that the variance observed originates from that of a trait and not from the research method (see Creswell 1994; Brewer and Hunter 1989). Still, it is problematic to generalize the overall results without any limitations. This study only focuses on the coatings and sealants industry. Of course, other industries will have specific value-chain structures and may not give any point to pursue cooperative or non-cooperative VCM. Furthermore, the sample consists of German firms. This selection may put constraints on the generalizability of the results to other countries. Hence, future research may consider testing the framework in other national contexts.

The main deficiency of most agent-based models, namely the missing real data base, is remedied by using the collected case study data as input data of the simulation. This implies that the environment of the simulation is strongly aligned with the five case studies. In a nutshell, the qualitative information of the cases are translated and quantified to build an agent-based model. Moreover, the case study data allow a micro-validation. But to get stable simulation results, the complexity of the present model has to be reduced gradually. Consequently, only a reduced number of agent types (i.e. supplier, manufacturer, and applicator) can be considered. This implicates an exclusion of influencers who impact the purchasing decision of suppliers' immediate as well as downstream customers. Next, the characteristics of agents and innovations are minimized. In the real business environment, the knowledge bases of value-chain actors are much more complex and supplier innovations are often characterized by more than two features. In addition, the history of value-chain relationships is not included in this model as it goes beyond the scope of the thesis. These limitations have to be accepted to profit from the advantage of simulation. Once again, the aim of the simulation is to model a simplified picture of the real world.

As presented in Sect. 7.8, the statistical analysis shows that the variance explained by the identified factors is 32 % at most. Indeed, this result is considered good. However, it suggests that the percentage rate could be enhanced by adapting or broadening the design of experiment. It is believed that additional factors exist that impact the supplier's marketing performance. First ideas of future research projects will be presented in Sect. 9.3. As mentioned before, the present agent-based model is also characterized by uncontrollable nuisance factors which make it harder for researchers to explain a higher proportion of variance (see Sect. 7.9).

In conclusion, it can be said that the present doctoral work reaches its goals. Overall, it fosters the understanding of VCM. The different studies and analyses have answered the question of how supplier innovations could be promoted and implemented more effectively and efficiently via VCM. The strong alignment of qualitative research and computational modeling ensures the validity of the simulation study. In consequence, the dissertation allows for going far beyond current VCM research. Future projects in this field can be based on the present results.

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Chapter 9
Conclusions

The final chapter of this study focuses on the implications for theory, managerial practice and future research. First, the central contributions to research are summarized. Second, the aim is to derive specific statements and recommendations for future marketing decisions of suppliers of entering goods. Lastly, possible directions of future research projects are provided.

9.1 Implications for Theory

This doctoral project is grounded on the theory of marketing and innovation. Following Jeannet (2006), VCM describes a marketing strategy to go beyond traditional boundaries of marketing and overcome immediate customers' resistance of innovation successfully. When the doctoral project started, knowledge of VCM was very limited. Beyond that a surprising lack of theoretical research on the relevance of VCM was experienced. To disclose the important role of VCM, the current work follows a gradual but holistic approach toward VCM. It exchanges macro with micro level, delivers a comprehensive overview of real-world examples on how VCM can be done, as well as synthesizes theoretical and practical know-how. In brief, this dissertation provides new insights that potentially contribute to the formation of a more widely accepted perspective on the impact of VCM when marketing supplier innovations.

In some more detail, this thesis contributes to research in the following ways: First, the thesis fosters the combination of VCM and marketing of innovation on a theoretical and empirical level as well as the combination of different research methods. In other words, the value of the current doctoral project lies in its originality in combing a rarely investigated marketing phenomenon with a progressive method. Current research is often not executed in a combined way. It relies solely on traditional methods of analysis and suffers from the deficiencies of each research method. In consequence, this thesis contributes by identifying potential

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advantages of a multi-method approach, and giving specific suggestions for an integrated procedural approach. This, in turn, allows for going beyond documented research to make use of mutual complementary advantages.

Second, the thesis outlines the high importance and relevance of VCM in practical examples and is able to expand findings of prior marketing research. Furthermore, it points out that a distinction between cooperative and non-cooperative VCM has to be made. Existing research does not consider and compare different VCM strategies. However, it is awfully important because material suppliers should select their VCM strategy according to the given conditions in the value chain they are a part of. Experimenting with the VCM model delivers new insights. It shows that the performance of cooperative VCM and non-cooperative VCM is significantly influenced by the newness of innovation and the overlap between the knowledge bases of the involved actors. But cooperative VCM depends more strongly on the said factors than non-cooperative VCM.

Third, the thesis contributes by providing an agent-based model, which is able to serve as a foundation for future research. This conclusion is driven by the following three reasons: (1) The model presented in this dissertation is not too complex and it is documented on a detailed level, therefore, an adaptation or extension is possible with reasonable effort. (2) In contrast to other simulation models, the model presented in this dissertation is empirically calibrated by using the case study data to guide the modeling of parameters, agent interactions, and agent decision rules. This way, it allows for modeling of VCM processes through abstraction from reality. (3) The model leads to straightforward results that call for a more careful treatment of VCM in future theoretical and empirical works.

9.2 Implications for Practice

Besides the scientific goal to contribute an in-depth discussion and elaboration as well as an empirical explication and validation of the VCM concept, the current work also strives toward a transfer of the main insights to managerial practice. The study results confirm the importance of choosing the right marketing strategy to increase the success of supplier innovations. From this one can deduce some crucial findings for the suppliers' marketing or implementation projects in practice.

As discussed in Sect. 2.3, VCM is the marketing strategy that describes the practice of influencing the entire value chain to succeed in marketing innovations. This strategy requires a firm to have a deep understanding of the value chain in order to maximize its marketing performance. Adopting VCM implies at first that firms must cover a broader framework to map the value chain. They have to analyze and properly understand the players and their relationships at each level. This also includes identifying industry developments and drivers as well as government regulations. To become a real expert of a value chain or business system, a firm must possess trained employees and effective analytical and conceptual tools. Most supplier firms which are recruited as interview partners in the pilot and case study engage special VCM staff and establish a separate VCM business unit dealing with downstream customers. Second, firms intending to practice VCM should adapt and tailor their marketing mix. This includes the type of product, how it is promoted to customers, the method for distributing it to customers, and the amount the customers are willing to pay for it. Examples are a new product form, a prototype, ingredient branding, value pricing, flyers for the final application, and customer days (see Sects. 6.6.1 and 6.6.2). But to change a firm's marketing strategy successfully, top management support is indispensable. As VCM challenges traditional marketing approaches, conflicts with existing structures and mindsets are most probable. Only with strong senior executive support and commitment to transparent objectives can paralysis be avoided, which results from an inefficient matrix structure and unclear responsibilities of the business unit dedicated to the implementation of VCM. It is the challenge of the management team to offer sufficient resources, financial as well as human resources, and to reinforce empowerment to the team.

Customer intimacy is not only essential to understand the value chain and its processes but also to reduce the distance to downstream players. Therefore, a supplier no longer has to be separated from the stage of his downstream customers through his given position in the value chain. In fact, the value chain converts more and more into a value network and the distinction between immediate and downstream customers becomes less clear cut. By acquiring knowledge in the surrounding fields, suppliers are able to increase the overlap between their knowledge base and that of the downstream actors. They learn about applicators and develop communication strategies to reach them and to persuade them. This enhances interpersonal interaction and the applicators' feeling about the suppliers' competence to discuss on innovative topics. Levitt (1965) and Hovland and Weiss (1951) argue that a high-competence source is considered as highly credible. The authors further suggest that source credibility positively influences communication effectiveness. It enhances the supplier's attractiveness, which in turn positively affects the applicator's willingness to communicate with upstream players.

Next, the results of this thesis contribute to the planning and management of suppliers' marketing projects. The present analysis shows that the performance of a supplier's marketing project depends on the selected VCM strategy, the degree of newness the focal innovation has, and the overlap between the knowledge bases of the involved actors. As a result, suppliers who try to implement innovations along industrial value chains should decide a priori which VCM strategy to pursue. Otherwise, the supplier's VCM project is prompt to fail and causes unnecessary expense. The model presented here is intended as a tool for suppliers to evaluate the performance of cooperative and non-cooperative VCM in advance. The supplier's strategic decision should be based on the innovation that has to be promoted and the knowledge base he possesses.

The results show that a supplier should decide in favor of non-cooperative VCM if the said innovation implicates a new process technology. This is the only way to implement this type of innovation successfully. In this case, the integration of the manufacturer will just tie up capital without any chance of success. To develop an appropriate communication strategy, the supplier's marketing team should possess deep knowledge in technical fields, e.g. formulation and testing as well as converting and finishing of solutions.

If the supplier innovation provides a new functionality which can only be achieved by adding a new process technology (i.e. really new product), the supplier should also prefer non-cooperative VCM. Although Case 4 demonstrates a high effectiveness of cooperative VCM to promote a really new product, the risk to fail the first threshold "match of objectives" is simply too high. To address downstream customers successfully, the supplier's marketing team must know the manufacturer's as well as the applicator's business.

The situation is different if a supplier tries to implement an innovation which simply provides a new functionality. In this case, the relational dimension has to be considered. It implicates that suppliers should slightly prefer cooperative VCM even if both strategies more or less lead to similar success rates. But suppliers should invest a bit more time to implement their innovations without placing present business relationships with immediate customers at risk. To avoid communication problems, the supplier's marketing team should possess deep knowledge in application-related fields, e.g. functionality and aesthetics of final products as well as market trends and regulations.

In addition, there are also some implications for manufacturers. Due to their position in the value chain, they are well-informed on present upstream and downstream marketing projects. To remain competitive in the market, manufacturers must take advantage of this fact and should be more open to innovative ideas or products. They have to realize that supplier innovations do not always pose a threat. They can also offer them a chance to increase customer loyalty and to acquire new customers. This could be observed in Case 4 where the closure manufacturer supports the supplier to implement a really new product. Of course, this marketing project requires additional investments but increases the reputation of the manufacturer as a trendsetter.

Although downstream customers perceive suppliers as an important source of innovation, they benefit from it too rarely. This implies that they should proactively demand innovative solutions to solve their current problems or prevent new ones. If they frequently spread their needs into their value chain, they apply pressure to the intermediate stage. To date, the active demand is mainly limited to innovations that focus on the product functionality. But downstream customers should also request innovations that implicate a new process technology. This type of innovations can help applicators to handle the constant pressure to cut costs since it offers additional benefits, e.g. lower production costs and resource efficiency.

9.3 Implications for Future Research

Besides the implications for managerial practice, the thesis leaves some opportunities for future research. From a methodological point of view, the researcher could adapt the case study design by collecting data from a whole marketing or project team instead of focusing on key informants. This will help to protect against systematic bias based on interviews with individuals and provide new insights into the VCM process within a project team. Whenever possible, multiple respondents from the same case study firm were interviews to collect data, enhancing the validity of the responses.

Furthermore, the limitations discussed in Sect. 8.2 could also motivate subsequent analysis. First, influencers like industrial designers, experts for complementary products, or architects could be integrated as an additional type of agent in the VCM model. Their special characteristic is to influence the buying decision of immediate and downstream customers and thus the supplier's marketing performance. Influencers are well-informed on present upstream and downstream marketing projects and are open to innovative ideas. They establish relationships to manufacturers and applicators and are able to get them interested and to induce them to stimulate demand for innovations. Second, the agent-based model presented here could be adapted by including the history of value-chain relationships. This would make the model even more realistic. In the current version, the supplier's primary selection of a manufacturer or final applicator is randomized. Only after the first contact, a list of memorized and preferred firms is created. Most importantly, future steps should include an incorporation of the VCM model into the scientific world and the business practice. This may help to investigate additional factors that could explain some more variation of the supplier's performance. Researchers interested in testing other variables could program their own for this model.

To refine the empirical validation of the present model of VCM, the simulation outputs have to be confronted with an independent set of empirical data. One possibility to gather this data set is a large-scale survey of suppliers' past marketing projects to implement innovations along a value chain. The sample firms could be suppliers of any kind of chemical ingredients, i.e. it is not restricted to suppliers of coating and sealant materials. To recruit numerous supplier firms, a cooperation with the Verband der chemischen Industrie (VCI) should be targeted. Such cooperation is also valuable for the 1,600 chemical firms joining VCI. Certainly, a detailed empirical analysis of past marketing projects can help suppliers to adapt their marketing strategy and implementation process. This, in turn, will be essential to reduce innovation barriers and achieve a higher acceptance rate of supplier innovations. Moreover, the reputation of the chemical industry as innovation engine will be further improved. Based on the case study protocol, a questionnaire has to be developed in order to collect data of past marketing projects. The relevant sets of questions are: (1) supplier innovation and its features, (2) involved actors and their characteristics, (3) marketing strategy and implementation process, as well as

(4) marketing result. The filled questionnaires are added to the database created during the case study research.

Besides the aforesaid cross-sectional study, a longitudinal study should be a possibility to regularly track the marketing of supplier innovations over a longer period by questionnaire. This will help to gain a fuller picture of the dynamic of VCM processes.

It is also possible to make use of the developed agent-based VCM model in other business fields where similar problems or structures can be observed. An example is the field of multidivisional firms which are characterized by autonomous business divisions. These firms have the possibility to develop cross-divisional innovations. Philips, for example, combines the know-how of two separate divisions (i.e. consumer electronics and lighting technology) to present a LCD TV with 'Ambilight'—a lighting system that dynamically adjusts brightness and color based upon picture content (see Grote 2010). Like supplier innovations, the value associated with cross-divisional innovations is not always evident for all involved divisions. In other words, the benefit and the effort of an innovation are sometimes unequally distributed. As in the case of VCM, there is a division which benefits most (cf. applicators) and a division for which the effort is higher than the benefit (cf. manufacturers). As a result, the latter has low incentives to support cross-divisional projects and thus hampers in-house cooperations. This, in turn, requires internal negotiations. To model the problem in multidivisional firms, different types of agents have to be initiated: e.g. division 1, division 2, and division 3. Like in the agent-based model presented here, each division is specialized and starts the simulation with specific attribute values and with different knowledge bases. Modeling multidivisional firms may provide new insights into how to foster cross-divisional innovations.

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Appendix A Details—Pilot Study

Appendix A1 Letter of Introduction

Dear _______,

I am a research assistant and a PhD student at Hamburg University of Technology. Our research addresses issues of marketing and innovation management. I focus on the topic of Value Chain Marketing (VCM) in coating industries. VCM implies that supplier firms enlarge their target group beyond their immediate customers and address their customers down the value chain as well.

My research project focuses on several aspects:

- Coating and its industries/applications (e.g. automotive, packaging)
- Value chains and their specific characteristics (e.g. number of stages, value-chain actors per stage, power distribution)
- Relevance/importance of VCM in coating industries/applications
- Specific examples of VCM

You as an expert in the field of coating can help to unfold the black box of VCM. If possible, I would be pleased to meet you personally at the European Coatings Show 2011 (29–31 March) in Nuremberg.

If you have any questions, please do not hesitate to contact me.

Thank you in advance.
Best regards,
Stephanie Toth

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Appendix A2 List of Interview Partners

No.	Interview ID	Interviewed person		Interviewed organization		Date	Place
		ID	Function	ID	Description		
1	Int-1	P-01	Director Product Management Additives (automotive industry)	F-01	Material supplier	03/29/2011	ECS, Nuremberg
2	Int-2	P-02	Technology Manager Surface Modifier (furniture industry)	F-02	Material supplier	03/29/2011	ECS, Nuremberg
3	Int-3	P-03	Senior Manager Textile Coating (automotive, apparel & sports industry)	F-03	Material supplier	03/30/2011	ECS, Nuremberg
4	Int-4	P-04	Manager Global Strategic Marketing (furniture industry)	F-04	Material supplier	03/30/2011	ECS, Nuremberg
5	Int-4	P-05	Global Strategic Marketing (furniture industry)	F-04	Material supplier	03/30/2011	ECS, Nuremberg
6	Int-5	P-06	Chief Technology Manager (packaging industry)	F-05	Material supplier	03/30/2011	ECS, Nuremberg
7	Int-6	P-07	Technical Manager BU Wood & Furniture (furniture industry)	F-06	Material supplier	03/30/2011	ECS, Nuremberg
8	Int-6	P-08	Technical Manager BU Dispersions (furniture industry)	F-06	Material supplier	03/30/2011	ECS, Nuremberg
9	Int-7	P-09	Global Strategic Marketing Manager (shipping industry)	F-07	Material supplier	03/31/2011	ECS, Nuremberg
10	Int-8	P-10	General Manager (automotive industry)	R-01	Research firm	03/30/2011	ECS, Nuremberg
11	Int-9	P-11	Head of Global Competence Center Paint (construction industry)	F-08	Material supplier	03/30/2011	ECS, Nuremberg
12	Int-10	P-12	Marketing Management Industrial Coatings (construction industry)	F-09	Material supplier	03/30/2011	ECS, Nuremberg

Appendix A3 Interview Protocol

Block I: Background

Name	______________________
Company	______________________
Value Chain	______________________
Division	______________________
Industry	______________________
Job title	______________________
Years in position	______________________
Years with firm	______________________
Years in marketing	______________________

Block II: Coating and Its Industries/Applications

1. Which are the most important coating industries/applications?
2. Is coating of great importance to the final product(s)? And why?
3. Which specific demands must coating meet?

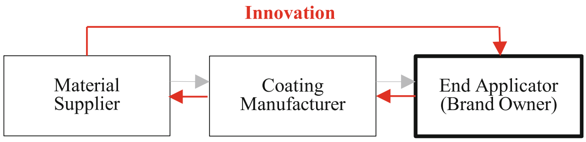
Block III: Application Value Chains

4. How is the specific (application) value chain structured?
   a. Concerning the number of stages and the distance between the supplier of coating materials and the end applicator
   b. Concerning the value-chain actors per stage and their roles in the value chain
   c. Concerning the interaction structures
   d. Concerning the power distribution
   e. Concerning the competitive pressure
   f. Concerning the degree of vertical integration

Block IV: Value Chain Marketing

Definition VCM

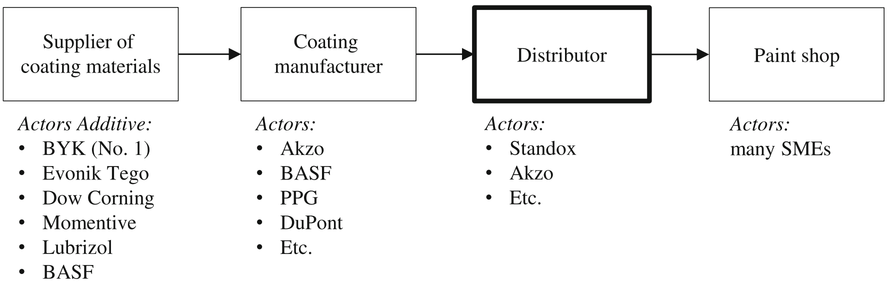
VCM is a practice of influencing the entire value chain to succeed in marketing an innovative product. It requires a firm to have a deep and complete understanding of the value chain in order to maximize marketing effectiveness. Therefore, VCM always targets at least one subsequent stage in the value chain.



5. Is VCM a relevant and an important topic in coating industries/applications?
6. Do suppliers of coating materials directly target end applicators?
7. Does a regular interaction between suppliers and end applicators exist?
8. How is the communication/interaction process structured?
9. Do suppliers primarily pursue VCM to implement their innovations?
10. What are specific examples of the usage of VCM?
11. Is VCM a promising strategy to increase the success of supplier innovations?

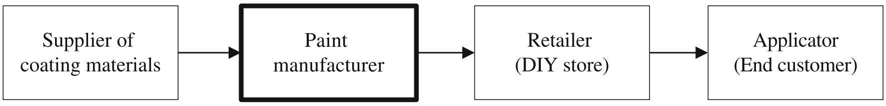
Appendix A4 Further Coating Applications

Value chain automotive refinishing



Value chain construction (architectural) coating

Decorative

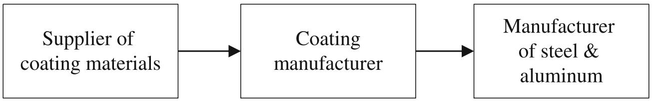


Coating materials:
- Binder
- Pigments
- Additives
- Etc.

Most important actor:
Akzo = global market leader

Actors:
- OBI
- Bauhaus
- Hornbach
- Hagebau
- Etc.

Industrial

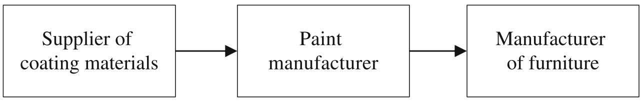


Actors:
- Big chemical firms like BASF and Bayer
- Some smaller companies which offer specialties

Actors Coil Coating:
- Akzo
- Beckers
- BASF Coatings
- PPG
- DuPont

Actors:
- 200 actors worldwide
- Europe: Tata Steel, Arcetor Mittal
- Germany: ThyssenKrupp, Salzgitter
- Russia = important market

Value chain furniture (wood) coating



Coating materials:
- Binder
- Pigments
- Additives

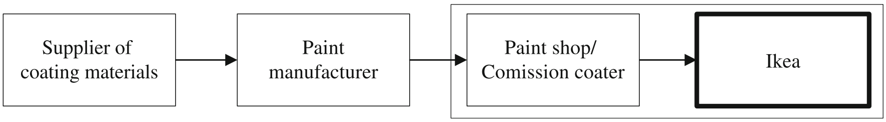
Actors:
about 10 big actors = 60-70% market share (e.g. Evonik Tego, BYK)

Actors:
10 big actors = 50% market share (e.g. AkzoNobel, PPG, Sherwin Williams)

Europe: many SMEs
Italia: Milesi

Actors:
- IKEA
- Hülsta
- Many small firms (especially in Italia)

Very fragmented and complex market

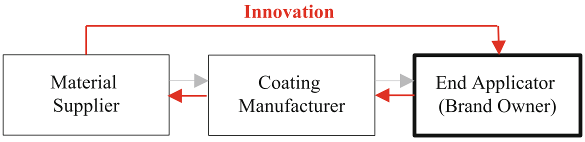


Appendix B Details—Case Study

Appendix B1 Letter of Introduction

Dear _______,

I am a research assistant and a PhD student at Hamburg University of Technology. Our research addresses issues of marketing and innovation management. I focus on the topic of Value Chain Marketing (VCM). Immediate customers (e.g. coating manufacturers) often have low incentives to adopt supplier innovations as these innovative products change their processes and interrupt their cost leadership strategy. Actually, supplier innovations primarily provide an added value to downstream customers (e.g. end applicators).



A prominent marketing strategy for material suppliers to implement their innovations is to pursue VCM. Unlike traditional push marketing, VCM refers to develop comprehensive market intelligence and promote innovations across all levels of the value chain. It implies that supplier firms enlarge their target group beyond their immediate customers and address their downstream customers as well. If supplier firms manage to create preferences at the downstream stage, end applicators are often willing to support the supplier innovation and convince the intermediate stage (e.g. the manufacturer).

To understand the VCM phenomenon, I want to conduct multiple case studies and interview both the source (e.g. the material supplier) as well as the recipient (e.g. the end applicator) of a supplier innovation which is promoted via VCM.

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Material supplier: Now the question arises. Is there any innovation you remember that is directly presented to the downstream customer (i.e. the end applicator)? If yes, I am very interested in comparing notes with you on this specific case.

End applicator: Now the question arises. Is there any innovation you remember that is directly presented to you by the material supplier? If yes, I am very interested in comparing notes with you on this specific case.

If you have any questions, please do not hesitate to contact me.

Thank you in advance.
Best regards,
Stephanie Toth

Appendix B2 List of Interview Partners

Case	Interview ID	Interviewed person		Interviewed organization		Date	Type of interview
		ID	Function	ID	Description		
1	Int-1	P-01	Marketing Manager Packaging	F-01	Material supplier	08/17/2011	Face-to face
	Int-2	P-02	Head of Corporate Packaging	F-02	End applicator	09/13/2011	Telephone
	Int-3	P-03	Head of Packaging	F-03	End applicator	08/31/2011	Telephone
	Int-4	P-04	Packaging Manager			07/26/2011	Face-to face
2	Int-5	P-05	Marketing Manager Packaging	F-04	Material supplier	08/17/2011	Face-to face
	Int-6	P-06	Head of Global Marketing	F-05	Material supplier	10/13/2011	Face-to face
	Int-7	P-07	Head of Packaging Development	F-06	End applicator	09/02/2011	Face-to face
	Int-8	P-08	Packaging Development			10/12/2011	Face-to face
3	Int-9	P-09	Head of Textile Coating	F-07	Material supplier	07/12/2011	Face-to face
	Int-10	P-10	Senior Manager Textile Coating			09/21/2011	Telephone
	Int-11	P-11	Group Project Manager R&D	F-08	Manufacturer	12/01/2011	Telephone
	Int-12	P-12	Head of Synthetic Leather	F-09	End applicator	10/05/2011	Telephone

(continued)

Case	Interview ID	Interviewed person		Interviewed organization		Date	Type of interview
		ID	Function	ID	Description		
4	Int-13	P-13	Chief Technology Officer	F-10	Material supplier	07/27/2011	Face-to face
	Int-14	P-14	Consultant (previous CEO)			08/30/2011	Face-to face
	Int-15	P-15	Technical Service & Development			08/30/2011	Face-to face
	Int-16	P-16	CEO	F-11	Manufacturer	09/15/2011	Telephone
	Int-17	P-17	Quality Manager	F-12	End applicator	09/01/2011	Telephone
5	Int-18	P-18	Global Marketing Manager	F-13	Material supplier	02/22/2012	Face-to face
	Int-19	P-19	Engineering Manager	F-14	End applicator	02/22/2012	Face-to face

Appendix B3 Interview Protocol

Block I: Background

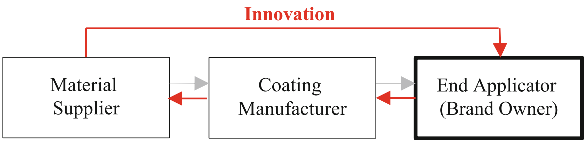
Name ______________________________
Company ______________________________
Value Chain ______________________________
Division ______________________________
Industry ______________________________
Job title ______________________________
Years in position ______________________________
Years with firm ______________________________

1. What is the major business of your firm?
2. What is the major goal of your firm?
3. What are the key issues/competitive challenges facing your firm?
4. Which role do you play in the value chain?
5. Do you know the whole value chain?
6. Do you focus on your immediate and/or downstream customers?
7. What about innovations in your value chain?

Block II: Past Marketing Strategies of Innovations

Definition of VCM

VCM is a practice of influencing the entire value chain to succeed in marketing an innovative product. It requires a firm to have a deep and complete understanding of the value chain in order to maximize marketing effectiveness. Thus, VCM always targets at least one subsequent stage in a value chain.



The nature of the VCM process depends on the timing of integrating the immediate customer (i.e. the coating manufacturer). Based on the pilot study results, we differentiate between the integration of the manufacturer at the very beginning or at a later stage of the VCM process.

8. Is VCM a relevant and an important topic in your firm?
9. Are you currently undergoing, or have you undergone VCM attempts in the past?
10. If yes, how did these marketing attempts differ?
    a. Concerning the chosen VCM strategy and the process behind
    b. Concerning the product/innovation that should be promoted
    c. Concerning the involved value-chain actors
11. Which were the main challenges in marketing these products/innovations?
12. What were the results of these marketing attempts?

Block III: Specific Marketing Project/Attempt

13. Who were the actors involved in this specific marketing attempt?
14. Which supplier product/innovation should be promoted?
15. Was there an urgent need for this innovation?
16. Which were the specific characteristics of this innovation?
17. Which VCM approach was chosen? And why?
18. How was the marketing process structured? From preparation to communication?
19. What was the specific content of communication (message)?
20. Did the interlocutors have problems in communication?
21. Which specific marketing activities were taken?
22. What was the result of this specific approach? And why?

Appendix C Details—Agent-Based Simulation Study

Appendix C1 Details of Cost Calculation

Calculation of the Non-Cooperative Marketing Cost 1 ($Cost1_{NC}$)

- Max. $Cost1_{NC} = 15$
- Condition: $K \geq 3$
- Supplier's message: $K_1^S \times A_1^S + K_2^S \times A_2^S$ (min: $3 \times 1 + 3 \times 1 = 6$; max: $6 \times 3 + 6 \times 3 = 36$)
- Applicator's message: $K_1^A \times A_1^A + K_2^A \times A_2^A$ (min: $3 \times 1 + 3 \times 1 = 6$; max: $6 \times 3 + 6 \times 3 = 36$)
- $\Delta M_{min} = 0$, $\Delta M_{max} = 30 \rightarrow C1_{NC} = 15/30$

Calculation of the Non-Cooperative Marketing Cost 2 ($Cost2_{NC}$)

- Max. $Cost2_{NC} = 15$
- Condition: $K \geq 3$ *and* $A \geq 2$
- Offered customer value: $K_1^S \times E_1^S + K_2^S \times E_2^S$ (min: 0 *if* $A < 2$; max: $6 \times 3 + 6 \times 3 = 36$)
- Expected customer value: $K_1^A \times E_1^A + K_2^A \times E_2^A$ (min: 0 *if* $A < 2$; max: $6 \times 3 + 6 \times 3 = 36$)
- $\Delta CV_{min} = 0$, $\Delta CV_{max} = 36 \rightarrow C2_{NC} = 15/36$

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Appendix C2 Documentation of Program Code

```
globals [
  n-knowledge-fields
  max-mc-length
  M
  joint-M
  EM
  SCV
  SMCV
  ECV

  s-customer-value-tolerance
  s-m-customer-value-tolerance
  randomsupplier
  randomapplicator
  randommanufacturer

  nc-costfactor
  c-costfactor
  cost
  nc-knowledge-overlap
  c-knowledge-overlap
  setup-reminder
  implementation-list
  applicator-implementation-list
  supplier-implementation-list

  ;strategy
  ;innovation-rate
  ;number-of-suppliers
  ;big-supplier's-ratio
  ;number-of-manufacturers
  ;number-of-applicators
]

breed [suppliers supplier]
breed [manufacturers manufacturer]
breed [applicators applicator]

suppliers-own [
  ;kene
  sknowledge-fields
  samounts
  sexpertises
  smc
  succeed?
  further-improvement?
  implemented?

  ;supplier
  capital
  supplier-applicator-memory
  supplier-manufacturer-memory
  applicator-preference
  manufacturer-preference
  active?
```

```
 suppliertick
 costs
 sumcosts
 acceptance?
 attributes
 strategy-choice
 ]

manufacturers-own [
 ;kene
 mknowledge-fields
 mamounts
 mexpertises
 ]

applicators-own [
 ;kene
 aknowledge-fields
 aamounts
 aexpertises
 amc

 customer-value-memory
 selection-progress
 cooperative-manufacturer-link-memory
 cooperative-supplier-link-memory
 non-cooperative-supplier-link-memory
 past-supplier-strategy
 ]

to setup
 ifelse trials-number > 0
 [
  no-display
  __clear-all-and-reset-ticks
  ask patches [set pcolor white]
  set max-mc-length 2
  set n-knowledge-fields 6
  set implementation-list []
  set applicator-implementation-list []
  set supplier-implementation-list []

  initialise-manufacturers
  ask manufacturers [setup-manufacturer]

  initialise-applicators
  ask applicators [setup-applicator]

  initialise-supplier
  ask suppliers [setup-supplier]

  activate-suppliers
  choose-strategy
  setup-output
  set setup-reminder true
 ]
 [print "please insert trial-number"]
end

to initialise-supplier
 create-suppliers number-of-suppliers
```

```
  [
   set capital initial-capital
   set further-improvement? true
   set succeed? false
   set active? false
   set suppliertick 0
   set costs 0
   set sumcosts 0
  ]
  ask n-of round (big-supplier's-ratio * number-of-suppliers) suppliers
  [set capital 2 * capital]
  ask suppliers
  [
   set smc []
   set sknowledge-fields []
   set samounts []
   set sexpertises []
   set applicator-preference -1
   set manufacturer-preference -1
  ]
end

to initialise-manufacturers
  create-manufacturers number-of-manufacturers
  ask manufacturers
  [
   set mknowledge-fields []
   set mamounts []
   set mexpertises []
  ]
end

to initialise-applicators
  create-applicators number-of-applicators
  ask applicators
  [
   set amc []
   set aknowledge-fields []
   set aamounts []
   set aexpertises []
   set customer-value-memory 0
   set selection-progress 1
   set cooperative-manufacturer-link-memory -1
   set cooperative-supplier-link-memory -1
   set non-cooperative-supplier-link-memory -1
   set past-supplier-strategy "-"
  ]
end

to activate-suppliers
  let activesuppliernumber round (innovation-rate * number-of-suppliers)
  ask n-of activesuppliernumber suppliers [set active? true]
end

to choose-strategy
  let active-supplierlist [who] of suppliers with [active? = true]
  let i 0
  while [i < length active-supplierlist]
```

```
  [let a-s-number item i active-supplierlist
   ask supplier a-s-number [set strategy-choice random 2]
   set i i + 1]
end

to setup-supplier
  make-skene
  make-smc
end

to setup-manufacturer
  make-mkene
end

to setup-applicator
  make-akene
  make-amc
end

to make-skene
  let kene-capacity 8
  while [length sknowledge-fields < kene-capacity]
  [
   if length sknowledge-fields <= 2 [set sknowledge-fields lput (random 2 + 1) sknowledge-fields]
   if length sknowledge-fields = 3 [set sknowledge-fields lput (random 4 + 3) sknowledge-fields]
   if length sknowledge-fields > 3 and length sknowledge-fields <= 5
   [
    let a item 3 sknowledge-fields
    ifelse a <= 3
    [set sknowledge-fields lput (random 2 + 3) sknowledge-fields]
    [set sknowledge-fields lput (random 2 + 5) sknowledge-fields]
   ]
   if length sknowledge-fields > 5 [set sknowledge-fields lput (random 3 + 4) sknowledge-fields]
  ]

  let i 0
  while [i < kene-capacity]
  [
   let knowledge item i  sknowledge-fields
   ifelse knowledge <= 2
   [set samounts lput (random 1 + 3) samounts]
   [set samounts lput (random 3 + 1) samounts]
   set i i + 1
  ]

  while [length sexpertises < kene-capacity]
  [set sexpertises fput ((random 3) + 1) sexpertises]
end

to make-mkene
  let kene-capacity 8
  while [length mknowledge-fields < kene-capacity]
  [
   if length mknowledge-fields <= 1 [set mknowledge-fields lput (random 2 + 1) mknowledge-fields]
   if length mknowledge-fields > 1 and length mknowledge-fields <= 5
   [set mknowledge-fields lput (random 2 + 3) mknowledge-fields]
   if length mknowledge-fields > 5 [set mknowledge-fields lput (random 2 + 5) mknowledge-fields]
  ]

  let i 0
```

```
  while [i < kene-capacity]
  [
   let knowledge item i mknowledge-fields
   ifelse knowledge >= 3 and knowledge <= 4
   [set mamounts lput (random 1 + 3) mamounts]
   [set mamounts lput (random 3 + 1) mamounts]
   set i i + 1
  ]

  while [length mexpertises < kene-capacity]
  [set mexpertises fput ((random 3) + 1) mexpertises]
end

to make-akene
  let kene-capacity 8
  while [length aknowledge-fields < kene-capacity]
  [
   if length aknowledge-fields <= 4 [set aknowledge-fields lput (random 2 + 5) aknowledge-fields]
   if length aknowledge-fields > 4 [set aknowledge-fields lput (random 4 + 1) aknowledge-fields]
  ]

  let i 0
  while [i < kene-capacity]
  [
   let knowledge item i aknowledge-fields
   ifelse knowledge >= 5
   [set aamounts lput (random 1 + 3) aamounts]
   [set aamounts lput (random 3 + 1) aamounts]
   set i i + 1
  ]

  while [length aexpertises < kene-capacity]
  [set aexpertises fput ((random 3) + 1) aexpertises]
end

to make-smc
  let numberlist []
  set smc []
  let i 0
  while [i < length sknowledge-fields]
  [
   let number 0
   let knowledge item i sknowledge-fields
   foreach sknowledge-fields [if ? = knowledge and knowledge >= 3 [set number number + 1]]
   set numberlist lput number numberlist
   set i i + 1
  ]

  let sknowledge-fields-double sknowledge-fields
  let first-largest-occurrence max numberlist
  let first-largest-occurrence-position position first-largest-occurrence numberlist
  set numberlist replace-item first-largest-occurrence-position numberlist 0
  set smc fput first-largest-occurrence-position smc
  let firstvalue item first-largest-occurrence-position sknowledge-fields

  let numberlist2 []
  let i2 0
   while [i2 < length sknowledge-fields]
   [
    let knowledge2 item i2 sknowledge-fields
```

```
    foreach sknowledge-fields-double [if knowledge2 = firstvalue
    [set sknowledge-fields-double replace-item i2 sknowledge-fields-double 0]]
    set knowledge2 item i2 sknowledge-fields-double
    let number2 0
    foreach sknowledge-fields-double [if ? = knowledge2 and knowledge2 >= 3 [set number2 number2 + 1]]
    set numberlist2 lput number2 numberlist2
    set i2 i2 + 1
   ]

  let second-largest-occurrence max numberlist2
  let second-largest-occurrence-position position second-largest-occurrence numberlist2
  let secondvalue item second-largest-occurrence-position sknowledge-fields
  ifelse secondvalue >= 3
  [set smc fput second-largest-occurrence-position smc]
  [set sknowledge-fields-double sknowledge-fields
   set second-largest-occurrence max numberlist
   let second-alternative-occurrence-position position second-largest-occurrence numberlist
   set smc fput second-alternative-occurrence-position smc]

  set smc sort smc
end

to make-amc
  let numberlist []
  set amc []
  let i 0
  while [i < length aknowledge-fields]
  [
   let number 0
   let knowledge item i aknowledge-fields
   foreach aknowledge-fields [if ? = knowledge and knowledge >= 3 [set number number + 1]]
   set numberlist lput number numberlist
   set i i + 1
  ]

  let aknowledge-fields-double aknowledge-fields
  let first-largest-occurrence max numberlist
  let first-largest-occurrence-position position first-largest-occurrence numberlist
  set amc fput first-largest-occurrence-position amc
  let firstvalue item first-largest-occurrence-position aknowledge-fields

  let numberlist2 []
  let i2 0
  while [i2 < length aknowledge-fields]
  [
   let knowledge2 item i2 aknowledge-fields
   foreach aknowledge-fields-double [if knowledge2 = firstvalue
   [set aknowledge-fields-double replace-item i2 aknowledge-fields-double 0]]
   set knowledge2 item i2 aknowledge-fields-double
   let number2 0
   foreach aknowledge-fields-double [if ? = knowledge2 and knowledge2 >= 3 [set number2 number2 + 1]]
   set numberlist2 lput number2 numberlist2
   set i2 i2 + 1
  ]

  let second-largest-occurrence max numberlist2
  let second-largest-occurrence-position position second-largest-occurrence numberlist2
  set amc fput second-largest-occurrence-position amc
  let secondvalue item second-largest-occurrence-position aknowledge-fields

  set amc sort amc
end
```

```
to go
 if trials-number = 0 [__clear-all-and-reset-ticks stop]
 ifelse trials-number >= 0 and setup-reminder = true
 [
  ifelse all? suppliers with [active? = true]
  [capital = 0 or succeed? = true or further-improvement? = false]
  [set trials-number trials-number - 1 ask suppliers [plotoutput] plotimplementation setup]
   [if count suppliers > 0
     [
      set randomsupplier one-of suppliers with [active? = true and capital > 0 and succeed? = false]
      while [randomsupplier = nobody]
      [set randomsupplier one-of suppliers with [active? = true and capital > 0 and succeed? = false]]

      ask randomsupplier
      [
       choose-applicator
       choose-manufacturer
      ]
    ]
    pursue-vcm
   ]
  tick
 ]
 [print "please reset first" stop]
end

to choose-applicator
 ifelse applicator-preference != -1
 [set randomapplicator applicator applicator-preference]
 [set randomapplicator one-of applicators]
end

to choose-manufacturer
 set randommanufacturer one-of manufacturers
end

to pursue-vcm
 if randomsupplier != nobody
 [ask randomsupplier
   [set costs 0
    ifelse further-improvement? = true and succeed? = false
   [if strategy = "non-cooperative" [pursue-non-cooperative-vcm]
    if strategy = "cooperative" [pursue-cooperative-vcm]
    if strategy = "random strategy"
    [if strategy-choice = 1 [pursue-non-cooperative-vcm]
     if strategy-choice = 0 [pursue-cooperative-vcm]]
   ]
   [stop]
   ]
 ]
end

to pursue-non-cooperative-vcm
 let a item 0 smc
 let a0 item a sknowledge-fields
 let b item 1 smc
 let a1 item b sknowledge-fields
 let a3 0
 let a4 0
```

```
  let appllist []

  ask randomapplicator
  [
   let d item 0 amc
   set a3 item d aknowledge-fields
   set appllist fput a3 appllist
   let f item 1 amc
   set a4 item f aknowledge-fields
   set appllist fput a4 appllist
  ]

  ifelse member? a0 appllist or member? a1 appllist
  [create-M
   ask randomapplicator [create-EM]
   pay-non-cooperative-marketing-cost-1
   calculate-SCV
   ask randomapplicator [calculate-ECV]
   compare-nc-customer-value]

  [set suppliertick suppliertick + 1
   set acceptance? 0
   pay-fixed-cost
   do-1st-non-cooperative-output
   adjust-expertises-of-supplier
   start-next-attempt
   set applicator-preference -1
   set implementation-list lput 0 implementation-list]
end

to create-M
  let smc0k item 0 smc
  let k0 item smc0k sknowledge-fields
  let smc1k item 1 smc
  let k1 item smc1k sknowledge-fields
  let smc0a item 0 smc
  let a0 item smc0a samounts
  let smc1a item 1 smc
  let a1 item smc1a samounts
  set M (k0 * a0) + (k1 * a1)
end

to create-EM
  let amc0k item 0 amc
  let k0 item amc0k aknowledge-fields
  let amc1k item 1 amc
  let k1 item amc1k aknowledge-fields
  let amc0a item 0 amc
  let a0 item amc0a aamounts
  let amc1a item 1 amc
  let a1 item amc1a aamounts
  set EM (k0 * a0) + (k1 * a1)
end

to pay-non-cooperative-marketing-cost-1
  let difference abs (M - EM)
  set cost abs ((15 / 30) * difference + 1)
  set capital (capital - cost)

  set costs costs + cost
  set sumcosts sumcosts + cost
```

```
  if capital < 2
  [ask randomsupplier [set capital 0]]
end

to calculate-SCV
  let smc0k item 0 smc
  let k0 item smc0k sknowledge-fields
  let a0 item smc0k samounts
  let a0double a0
  ifelse a0 < 2 [set a0 0][set a0 1]
  let smc1k item 1 smc
  let k1 item smc1k sknowledge-fields
  let a1 item smc1k samounts
  let a1double a1
  ifelse a1 < 2 [set a1 0][set a1 1]

  let smc0e item 0 smc
  let e0 item smc0e sexpertises
  let smc1e item 1 smc
  let e1 item smc1e sexpertises

  let elist []
  set elist lput e0 elist
  set elist lput e1 elist

  if k0 >= 3 and k0 <= 4 and k1 >= 5 and k1 <= 6
  [if a0double = 3 [set k0 6]]

  if k1 >= 3 and k1 <= 4 and k0 >= 5 and k0 <= 6
  [if a1double = 3 [set k1 6]]

  let list2 []
  set list2 lput k0 list2
  set list2 lput k1 list2

  set SCV (a0 *(k0 * e0)) + (a1 *(k1 * e1))
end

to calculate-ECV
  let amc0k item 0 amc
  let k0 item amc0k aknowledge-fields
  let a0 item amc0k aamounts
  ifelse a0 < 2 [set a0 0][set a0 1]
  let amc1k item 1 amc
  let k1 item amc1k aknowledge-fields
  let a1 item amc1k aamounts
  ifelse a1 < 2 [set a1 0][set a1 1]
  let amc0e item 0 amc
  let e0 item amc0e aexpertises
  let amc1e item 1 amc
  let e1 item amc1e aexpertises
  set ECV (a0 *(k0 * e0)) + (a1 *(k1 * e1))
end

to compare-nc-customer-value
  let knowapplicator []
  let knowsupplier []
  set knowsupplier remove-duplicates sknowledge-fields
  set knowsupplier sort knowsupplier

  ask randomapplicator
  [set knowapplicator remove-duplicates aknowledge-fields
```

```
 set knowapplicator sort knowapplicator]

set nc-knowledge-overlap 0

let i 0
while
[i < length knowsupplier]
[let svalue item i knowsupplier
 if member? svalue knowapplicator[set nc-knowledge-overlap nc-knowledge-overlap + 1]
 set i i + 1
]

if nc-knowledge-overlap = 0 [set s-customer-value-tolerance 1.00]
if nc-knowledge-overlap > 0 and nc-knowledge-overlap <= 2 [set s-customer-value-tolerance 1.00]
if nc-knowledge-overlap > 2 and nc-knowledge-overlap <= 4 [set s-customer-value-tolerance 1.00]
if nc-knowledge-overlap > 4 [set s-customer-value-tolerance 1.00]

ifelse SCV * s-customer-value-tolerance >= ECV
[ask randomapplicator
  [ifelse selection-progress <= 3 and SCV > customer-value-memory
   [
    set customer-value-memory SCV
    set selection-progress selection-progress + 1

    if past-supplier-strategy = "cooperative"
    [ask supplier cooperative-supplier-link-memory [set succeed? false set implemented? 0]]

     let j 0
     while [j < length implementation-list]
     [let value item j implementation-list
      let applicator item j applicator-implementation-list
      if value = 1 and applicator = [who] of randomapplicator
      [set implementation-list replace-item j implementation-list 0]
      set j j + 1]

     if past-supplier-strategy = "non-cooperative"
     [ask supplier non-cooperative-supplier-link-memory [set succeed? false set implemented? 0]

      set j 0
      while [j < length implementation-list]
      [let value item j implementation-list
       let applicator item j applicator-implementation-list
       if value = 1 and applicator = [who] of randomapplicator
       [set implementation-list replace-item j implementation-list 0]
       set j j + 1]
     ]
     set non-cooperative-supplier-link-memory [who] of randomsupplier
     set past-supplier-strategy "non-cooperative"

     ask randomsupplier
     [set implemented? 1
      set suppliertick suppliertick + 1
      set supplier-applicator-memory [who] of randomapplicator
      set applicator-preference [who] of randomapplicator
      pay-non-cooperative-marketing-cost-2
      set succeed? true
      set acceptance? 1
      set implementation-list lput 1 implementation-list
      do-2nd-non-cooperative-output]
   ]

   [ask randomsupplier
     [set suppliertick suppliertick + 1
```

```
        set implementation-list lput 0 implementation-list
        pay-non-cooperative-marketing-cost-2
        do-2nd-non-cooperative-output]
      ]
    ]
  ]
  [set suppliertick suppliertick + 1
   set acceptance? 0
   pay-non-cooperative-marketing-cost-2
   set implementation-list lput 0 implementation-list
   do-2nd-non-cooperative-output
   set applicator-preference -1
   start-next-round]
end

to pay-non-cooperative-marketing-cost-2
  let knowapplicator []
  let knowsupplier []
  set knowsupplier remove-duplicates sknowledge-fields
  set knowsupplier sort knowsupplier
  ask randomapplicator
  [set knowapplicator remove-duplicates aknowledge-fields
   set knowapplicator sort knowapplicator]
  set nc-knowledge-overlap 0
  let i 0
  while
  [i < length knowsupplier]
  [let svalue item i knowsupplier
   if member? svalue knowapplicator[set nc-knowledge-overlap nc-knowledge-overlap + 1]
   set i i + 1
  ]
  if nc-knowledge-overlap = 0 [set nc-costfactor 1.00]
  if nc-knowledge-overlap > 0 and nc-knowledge-overlap <= 2 [set nc-costfactor 1.00]
  if nc-knowledge-overlap > 2 and nc-knowledge-overlap <= 4 [set nc-costfactor 1.00]
  if nc-knowledge-overlap > 4 [set nc-costfactor 1.00]
  let difference abs (SCV - ECV)
  set cost abs (((15 / 36) * difference + 1) * nc-costfactor)
  set capital (capital - cost)
  set costs costs + cost
  set sumcosts sumcosts + cost
  if capital < 2
  [ask randomsupplier [set capital 0]]
end

to pursue-cooperative-vcm
  let a item 0 smc
  let a0 item a sknowledge-fields
  let b item 1 smc
  let a1 item b sknowledge-fields
  let a3 0
  let a4 0
  let appllist []
  ask randomapplicator
  [
```

```
  let d item 0 amc
  set a3 item d aknowledge-fields
  set appllist fput a3 appllist
  let f item 1 amc
  set a4 item f aknowledge-fields
  set appllist fput a4 appllist
 ]

 let identicalness 0
 ifelse a0 = a3
 [set identicalness identicalness + 1 set a3 0]
 [if a0 = a4 [set identicalness identicalness + 1 set a4 0]]
 ifelse a1 = a3
 [set identicalness identicalness + 1 set a3 0]
 [if a1 = a4 [set identicalness identicalness + 1 set a4 0]]

 ifelse identicalness = 2
 [create-joint-M
  ask randomapplicator [create-EM]
  pay-cooperative-marketing-cost-1
  calculate-SMCV
  ask randomapplicator [calculate-ECV]
  compare-c-customer-value]

 [set acceptance? 0
  pay-fixed-cost
  set suppliertick suppliertick + 1
  set implementation-list lput 0 implementation-list
  do-1st-cooperative-output
  set applicator-preference -1]
end

to pay-fixed-cost
 set capital capital - 2
 if capital < 2 [set capital 0]

 set costs costs + 2
 set sumcosts sumcosts + 2
end

to create-joint-M
 let smc0k item 0 smc
 let k0 item smc0k sknowledge-fields
 let smc1k item 1 smc
 let k1 item smc1k sknowledge-fields
 let smc0a item 0 smc
 let a0 item smc0a samounts
 let smc1a item 1 smc
 let a1 item smc1a samounts

 ask randommanufacturer
 [
  let i 0
  while [i < length mknowledge-fields]
  [let kvalue item i mknowledge-fields
   let avalue item i mamounts
   let evalue item i mexpertises
   if kvalue = k0 and avalue > a0
   [ask randomsupplier [set samounts replace-item smc0a samounts avalue
    set sexpertises replace-item smc0a sexpertises evalue]]
   if kvalue = k1 and avalue > a1
```

```
    [ask randomsupplier [set samounts replace-item smc1a samounts avalue
     set sexpertises replace-item smc1a sexpertises evalue]]
    set i i + 1
   ]
  ]

  set smc0k item 0 smc
  set k0 item smc0k sknowledge-fields
  set smc1k item 1 smc
  set k1 item smc1k sknowledge-fields
  set smc0a item 0 smc
  set a0 item smc0a samounts
  set smc1a item 1 smc
  set a1 item smc1a samounts
  set joint-M (k0 * a0) + (k1 * a1)
end

to pay-cooperative-marketing-cost-1
  let difference abs (joint-M - EM)
  set cost abs (((15 / 30) * difference) + 1)
  set capital (capital - cost)

  set costs costs + cost
  set sumcosts sumcosts + cost
  if capital < 2
  [ask randomsupplier [set capital 0]]
end

to calculate-SMCV
  let smc0k item 0 smc
  let k0 item smc0k sknowledge-fields
  let a0 item smc0k samounts
  let a0double a0
  ifelse a0 < 2 [set a0 0][set a0 1]
  let smc1k item 1 smc
  let k1 item smc1k sknowledge-fields
  let a1 item smc1k samounts
  let a1double a1
  ifelse a1 < 2 [set a1 0][set a1 1]

  let smc0e item 0 smc
  let e0 item smc0e sexpertises
  let smc1e item 1 smc
  let e1 item smc1e sexpertises

  if k0 >= 3 and k0 <= 4 and k1 >= 5 and k1 <= 6
  [if a0double = 3 [set k0 6]]

  if k1 >= 3 and k1 <= 4 and k0 >= 5 and k0 <= 6
  [if a1double = 3 [set k1 6]]

  let list2 []
  set list2 lput k0 list2
  set list2 lput k1 list2

  set SMCV (a0 *(k0 * e0)) + (a1 *(k1 * e1))
end

to compare-c-customer-value
  let knowmanufacturer []
  let knowapplicator []
  let knowsupplier []
```

```
ask randomapplicator
[set knowapplicator remove-duplicates aknowledge-fields
 set knowapplicator sort knowapplicator]

ask randommanufacturer
[set knowmanufacturer mknowledge-fields]

let combined-sm-knowledgefields sentence sknowledge-fields knowmanufacturer
set combined-sm-knowledgefields remove-duplicates combined-sm-knowledgefields
set combined-sm-knowledgefields sort combined-sm-knowledgefields

set c-knowledge-overlap 0

let i 0
while
[i < length combined-sm-knowledgefields]
[let svalue item i combined-sm-knowledgefields
 if member? svalue knowapplicator[set c-knowledge-overlap c-knowledge-overlap + 1]
 set i i + 1
]

if c-knowledge-overlap = 0 [set s-m-customer-value-tolerance 1.00]
if c-knowledge-overlap > 0 and c-knowledge-overlap <= 2 [set s-m-customer-value-tolerance 1.00]
if c-knowledge-overlap > 2 and c-knowledge-overlap <= 4 [set s-m-customer-value-tolerance 1.00]
if c-knowledge-overlap > 4 [set s-m-customer-value-tolerance 1.00]

ifelse SMCV * s-m-customer-value-tolerance >= ECV
[ask randomapplicator
  [
   ifelse selection-progress <= 3 and SMCV > customer-value-memory
   [
    set customer-value-memory SMCV
    set selection-progress selection-progress + 1

    if past-supplier-strategy = "cooperative"
    [ask supplier cooperative-supplier-link-memory [set succeed? false set implemented? 0]

     set i 0
     while [i < length implementation-list]
     [let value item i implementation-list
      let applicator item i applicator-implementation-list
      if value = 1 and applicator = [who] of randomapplicator
      [set implementation-list replace-item i implementation-list 0]
      set i i + 1]
    ]

    if past-supplier-strategy = "non-cooperative"
    [ask supplier non-cooperative-supplier-link-memory [set succeed? false set implemented? 0]]

    let j 0
     while [j < length implementation-list]
     [let value item j implementation-list
      let applicator item j applicator-implementation-list
      if value = 1 and applicator = [who] of randomapplicator
      [set implementation-list replace-item j implementation-list 0]
      set j j + 1]

    set cooperative-manufacturer-link-memory [who] of randommanufacturer
    set cooperative-supplier-link-memory [who] of randomsupplier

    set implementation-list lput 1 implementation-list

    set selection-progress selection-progress + 1
    set past-supplier-strategy "cooperative"
```

```
   ask randomsupplier
   [set implemented? 1
    set suppliertick suppliertick + 1
    set acceptance? 1
    set applicator-preference [who] of randomapplicator
    pay-cooperative-marketing-cost-2
    do-2nd-cooperative-output
    set manufacturer-preference [who] of randommanufacturer
    set supplier-manufacturer-memory [who] of randommanufacturer
    set supplier-applicator-memory [who] of randomapplicator
    set succeed? true]
  ]
  [ask randomsupplier
    [set acceptance? 0
     set suppliertick suppliertick + 1
     pay-cooperative-marketing-cost-2
     set implementation-list lput 0 implementation-list
     do-2nd-cooperative-output
     set applicator-preference -1
     set manufacturer-preference -1]]
 ]
]
[set suppliertick suppliertick + 1
 set acceptance? 0
 pay-cooperative-marketing-cost-2
 set implementation-list lput 0 implementation-list
 do-2nd-cooperative-output
 start-next-round
 set applicator-preference -1
 set manufacturer-preference -1]
end

to pay-cooperative-marketing-cost-2
 let knowmanufacturer []
 let knowapplicator []
 let knowsupplier []
 ask randomapplicator
 [set knowapplicator remove-duplicates aknowledge-fields
  set knowapplicator sort knowapplicator]
 ask randommanufacturer
 [set knowmanufacturer mknowledge-fields]
 let combined-sm-knowledgefields sentence sknowledge-fields knowmanufacturer
 set combined-sm-knowledgefields remove-duplicates combined-sm-knowledgefields
 set combined-sm-knowledgefields sort combined-sm-knowledgefields
 set c-knowledge-overlap 0
 let i 0
 while
 [i < length combined-sm-knowledgefields]
 [let svalue item i combined-sm-knowledgefields
  if member? svalue knowapplicator[set c-knowledge-overlap c-knowledge-overlap + 1]
  set i i + 1
 ]
 if c-knowledge-overlap = 0 [set c-costfactor 1.00]
 if c-knowledge-overlap > 0 and c-knowledge-overlap <= 2 [set c-costfactor 1.00]
```

```
 if c-knowledge-overlap > 2 and c-knowledge-overlap <= 4 [set c-costfactor 1.00]
 if c-knowledge-overlap > 4 [set c-costfactor 1.00]

 let difference abs (SMCV - ECV)
 set cost abs (((15 / 36) * difference + 1) * c-costfactor)
 set capital (capital - cost)
 set costs costs + cost
 set sumcosts sumcosts + cost

 if capital < 2
 [ask randomsupplier [set capital 0]]
end

to start-next-attempt
 let firstvalue-position item 0 smc
 let firstvalue item firstvalue-position sknowledge-fields
 let firstamount item firstvalue-position samounts
 let sknowledge-fields-double sknowledge-fields
 set sknowledge-fields-double replace-item firstvalue-position sknowledge-fields-double 0

 let smc1 smc

 let i 0
 while [i < length sknowledge-fields]
 [
  let value item i sknowledge-fields
  let amount item i samounts
  if value = firstvalue and amount > firstamount [set smc replace-item 0 smc i]
  set i i + 1
 ]

 let secondvalue-position item 1 smc
 let secondvalue item secondvalue-position sknowledge-fields
 let secondamount item secondvalue-position samounts
 set sknowledge-fields-double replace-item secondvalue-position sknowledge-fields-double 0

 let smc2 smc

 if smc2 = smc1
 [let i2 0
  while [i2 < length sknowledge-fields]
  [
   let value2 item i2 sknowledge-fields
   let amount2 item i2 samounts
   if value2 = secondvalue and amount2 > secondamount [set smc replace-item 1 smc i2]
   set i2 i2 + 1
  ]
 ]
end

to start-next-round
 adjust-amounts-of-supplier
 adjust-expertises-of-supplier
end

to adjust-amounts-of-supplier
 let location 0
 while [location < length sknowledge-fields]
 [let amount item location samounts
   ifelse member? location smc
   [if amount < 3 [set samounts replace-item location samounts (amount + 1)]]
 []
```

```
  set location location + 1
  ]
end

to adjust-expertises-of-supplier
  let location 0
  while [location < length sknowledge-fields]
  [let expertise item location sexpertises
   ifelse member? location smc
   [if expertise < 3 [set sexpertises replace-item location sexpertises (expertise + 1)]]
   []
   set location location + 1
  ]
end

to setup-output
  let filename (word "output-results.txt")
  file-open filename
  let mylist []
  set mylist ["S-Identity"";" "VCM"";" "R"";" "SMC-Triples"";" "SK1"";" "SK2"";" "DoI"";" "A-Identity"";"
  "AMC-Triples"";" "AK1"";" "AK2"";" "exp-DoI"";" "Sender-Ks"";" "Receiver-Ks"";" "KO"";" "M-
  Identity"";" "SCV"";" "nc-ECV"";" "SMCV"";" "c-ECV"";" "Attempt"";" "Accept"";" "Cost per Step"";"
  "Sum Costs"";" "Accept + Implement"]
  file-print mylist
  file-close-all

  let filename3 (word "last-row-output-results.txt")
  file-open filename3
  let mylist3 []
  set mylist ["S-Identity"";" "VCM"";" "R"";" "SMC-Triples"";" "SK1"";" "SK2"";" "DoI"";" "A-Identity"";"
  "AMC-Triples"";" "AK1"";" "AK2"";" "exp-DoI"";" "Sender-Ks"";" "Receiver-Ks"";" "KO"";" "M-
  Identity"";" "SCV"";" "nc-ECV"";" "SMCV"";" "c-ECV"";" "Attempt"";" "Accept"";" "Cost per Step"";"
  "Sum Costs"";" "Accept + Implement"]
  file-print mylist
  file-close-all

  let filename2 (word "implementation-output-results.txt")
  file-open filename2
  let mylist2 []
  set mylist ["S-Identity"";" "A-Identity"";" "Accept + Implement"]
  file-print mylist
  file-close-all
end

to do-1st-non-cooperative-output
  set attributes []
  let filename (word "output-results.txt")
  file-open filename

  set attributes lput (word [who] of randomsupplier ";") attributes
  set supplier-implementation-list lput [who] of randomsupplier supplier-implementation-list
  set attributes lput (word "1" ";") attributes
  set attributes lput (word innovation-rate ";") attributes

  let triple1 []
  let smc0 item 0 smc
  let k0 item smc0 sknowledge-fields
  set triple1 lput k0 triple1
  let a0 item smc0 samounts
  set triple1 lput a0 triple1
  let e0 item smc0 sexpertises
```

```
set triple1 lput e0 triple1

let triple2 []
let smc1 item 1 smc
let k1 item smc1 sknowledge-fields
set triple2 lput k1 triple2
let a1 item smc1 samounts
set triple2 lput a1 triple2
let e1 item smc1 sexpertises
set triple2 lput e1 triple2

set attributes lput (word  triple1 triple2 ";") attributes

set attributes lput (word k0 ";") attributes
set attributes lput (word k1 ";") attributes

if (k0 >= 3 and k0 <= 4) and (k1 >= 3 and k1 <= 4) [set attributes lput (word "0" ";") attributes]
if (k0 >= 3 and k0 <= 4 and k1 >= 5) or (k0 >= 5 and k1 >= 3 and k1 <= 4)
[set attributes lput (word "2" ";") attributes]
if (k0 >= 5) and (k1 >= 5) [set attributes lput (word "1" ";") attributes]

ask randomsupplier [set attributes lput (word [who] of randomapplicator ";") attributes
set applicator-implementation-list lput [who] of randomapplicator applicator-implementation-list]

ask randomapplicator
[
 let atriple1 []
 let amc0 item 0 amc
 let ak0 item amc0 aknowledge-fields
 set atriple1 lput ak0 atriple1
 let aa0 item amc0 aamounts
 set atriple1 lput aa0 atriple1
 let ae0 item amc0 aexpertises
 set atriple1 lput ae0 atriple1

 let atriple2 []
 let amc1 item 1 amc
 let ak1 item amc1 aknowledge-fields
 set atriple2 lput ak1 atriple2
 let aa1 item amc1 aamounts
 set atriple2 lput aa1 atriple2
 let ae1 item amc1 aexpertises
 set atriple2 lput ae1 atriple2

 ask randomsupplier [set attributes lput (word atriple1 atriple2 ";") attributes

 set attributes lput (word ak0 ";") attributes
 set attributes lput (word ak1 ";") attributes

 if (ak0 >= 3 and ak0 <= 4) and (ak1 >= 3 and ak1 <= 4) [set attributes lput (word "0" ";") attributes]
 if (ak0 >= 3 and ak0 <= 4 and ak1 >= 5) or (ak0 >= 5 and ak1 >= 3 and ak1 <= 4)
 [set attributes lput (word "2" ";") attributes]
 if (ak0 >= 5) and (ak1 >= 5) [set attributes lput (word "1" ";") attributes]]
]

let knowapplicator []
let knowsupplier []
set knowsupplier remove-duplicates sknowledge-fields
set knowsupplier sort knowsupplier

ask randomapplicator
[set knowapplicator remove-duplicates aknowledge-fields
 set knowapplicator sort knowapplicator]

set nc-knowledge-overlap 0
```

```
  let i 0
  while
  [i < length knowsupplier]
  [let svalue item i knowsupplier
   if member? svalue knowapplicator[set nc-knowledge-overlap nc-knowledge-overlap + 1]
   set i i + 1
  ]
  set attributes lput (word knowsupplier ";") attributes
  set attributes lput (word knowapplicator ";") attributes
  set attributes lput (word nc-knowledge-overlap ";") attributes

  set attributes lput (word [who] of randommanufacturer ";") attributes

  set attributes lput (word "-" ";" ) attributes
  set attributes lput (word "-" ";") attributes

  set attributes lput (word "-" ";") attributes
  set attributes lput (word "-" ";") attributes

  set attributes lput (word suppliertick ";") attributes
  set attributes lput (word acceptance? ";") attributes
  set attributes lput (word costs ";") attributes
  set attributes lput (word sumcosts ";") attributes
  set attributes lput (word implemented? ";") attributes

  file-print attributes
  file-close-all
end

to do-2nd-non-cooperative-output
  set attributes []
  let filename (word "output-results.txt")
  file-open filename

  set attributes lput (word [who] of randomsupplier ";") attributes
  set supplier-implementation-list lput [who] of randomsupplier supplier-implementation-list
  set attributes lput (word "1" ";") attributes
  set attributes lput (word innovation-rate ";") attributes

  let triple1 []
  let smc0 item 0 smc
  let k0 item smc0 sknowledge-fields
  set triple1 lput k0 triple1
  let a0 item smc0 samounts
  set triple1 lput a0 triple1
  let e0 item smc0 sexpertises
  set triple1 lput e0 triple1

  let triple2 []
  let smc1 item 1 smc
  let k1 item smc1 sknowledge-fields
  set triple2 lput k1 triple2
  let a1 item smc1 samounts
  set triple2 lput a1 triple2
  let e1 item smc1 sexpertises
  set triple2 lput e1 triple2

  set attributes lput (word  triple1 triple2 ";") attributes

  set attributes lput (word k0 ";") attributes
  set attributes lput (word k1 ";") attributes

  if (k0 >= 3 and k0 <= 4) and (k1 >= 3 and k1 <= 4) [set attributes lput (word "0" ";") attributes]
```

```
if (k0 >= 3 and k0 <= 4 and k1 >= 5) or (k0 >= 5 and k1 >= 3 and k1 <= 4)
[set attributes lput (word "2" ";") attributes]
if (k0 >= 5) and (k1 >= 5) [set attributes lput (word "1" ";") attributes]

ask randomsupplier [set attributes lput (word [who] of randomapplicator ";") attributes
set applicator-implementation-list lput [who] of randomapplicator applicator-implementation-list]

ask randomapplicator
[
 let atriple1 []
 let amc0 item 0 amc
 let ak0 item amc0 aknowledge-fields
 set atriple1 lput ak0 atriple1
 let aa0 item amc0 aamounts
 set atriple1 lput aa0 atriple1
 let ae0 item amc0 aexpertises
 set atriple1 lput ae0 atriple1

 let atriple2 []
 let amc1 item 1 amc
 let ak1 item amc1 aknowledge-fields
 set atriple2 lput ak1 atriple2
 let aa1 item amc1 aamounts
 set atriple2 lput aa1 atriple2
 let ae1 item amc1 aexpertises
 set atriple2 lput ae1 atriple2

 ask randomsupplier
 [
  set attributes lput (word atriple1 atriple2 ";") attributes
  set attributes lput (word ak0 ";") attributes
  set attributes lput (word ak1 ";") attributes

  if (ak0 >= 3 and ak0 <= 4) and (ak1 >= 3 and ak1 <= 4) [set attributes lput (word "0" ";") attributes]
  if (ak0 >= 3 and ak0 <= 4 and ak1 >= 5) or (ak0 >= 5 and ak1 >= 3 and ak1 <= 4)
  [set attributes lput (word "2" ";") attributes]
  if (ak0 >= 5) and (ak1 >= 5) [set attributes lput (word "1" ";") attributes]
 ]
]

let knowapplicator []
let knowsupplier []
set knowsupplier remove-duplicates sknowledge-fields
set knowsupplier sort knowsupplier

ask randomapplicator
[set knowapplicator remove-duplicates aknowledge-fields
 set knowapplicator sort knowapplicator]

set nc-knowledge-overlap 0

let i 0
while
[i < length knowsupplier]
[let svalue item i knowsupplier
 if member? svalue knowapplicator[set nc-knowledge-overlap nc-knowledge-overlap + 1]
 set i i + 1
]
set attributes lput (word knowsupplier ";") attributes
set attributes lput (word knowapplicator ";") attributes
set attributes lput (word nc-knowledge-overlap ";") attributes

set attributes lput (word [who] of randommanufacturer ";") attributes
```

```
  set attributes lput (word (SCV * s-customer-value-tolerance) ";") attributes
  set attributes lput (word (ECV) ";") attributes

  set attributes lput (word "-" ";") attributes
  set attributes lput (word "-" ";") attributes

  set attributes lput (word suppliertick ";") attributes
  set attributes lput (word acceptance? ";") attributes
  set attributes lput (word costs ";") attributes
  set attributes lput (word sumcosts ";") attributes
  set attributes lput (word implemented? ";") attributes

  file-print attributes
  file-close-all
end

to do-1st-cooperative-output
  set attributes []
  let filename (word "output-results.txt")
  file-open filename

  set attributes lput (word [who] of randomsupplier ";") attributes
  set supplier-implementation-list lput [who] of randomsupplier supplier-implementation-list
  set attributes lput (word "0" ";") attributes
  set attributes lput (word innovation-rate ";") attributes

  let triple1 []
  let smc0 item 0 smc
  let k0 item smc0 sknowledge-fields
  set triple1 lput k0 triple1
  let a0 item smc0 samounts
  set triple1 lput a0 triple1
  let e0 item smc0 sexpertises
  set triple1 lput e0 triple1

  let triple2 []
  let smc1 item 1 smc
  let k1 item smc1 sknowledge-fields
  set triple2 lput k1 triple2
  let a1 item smc1 samounts
  set triple2 lput a1 triple2
  let e1 item smc1 sexpertises
  set triple2 lput e1 triple2

  set attributes lput (word  triple1 triple2 ";") attributes

  set attributes lput (word k0 ";") attributes
  set attributes lput (word k1 ";") attributes

  if (k0 >= 3 and k0 <= 4) and (k1 >= 3 and k1 <= 4) [set attributes lput (word "0" ";") attributes]
  if (k0 >= 3 and k0 <= 4 and k1 >= 5) or (k0 >= 5 and k1 >= 3 and k1 <= 4)
  [set attributes lput (word "2" ";") attributes]
  if (k0 >= 5) and (k1 >= 5) [set attributes lput (word "1" ";") attributes]

  ask randomsupplier [set attributes lput (word [who] of randomapplicator ";") attributes
  set applicator-implementation-list lput [who] of randomapplicator applicator-implementation-list]
  ask randomapplicator
  [
   let atriple1 []
   let amc0 item 0 amc
   let ak0 item amc0 aknowledge-fields
   set atriple1 lput ak0 atriple1
   let aa0 item amc0 aamounts
```

```
 set atriple1 lput aa0 atriple1
 let ae0 item amc0 aexpertises
 set atriple1 lput ae0 atriple1

 let atriple2 []
 let amc1 item 1 amc
 let ak1 item amc1 aknowledge-fields
 set atriple2 lput ak1 atriple2
 let aa1 item amc1 aamounts
 set atriple2 lput aa1 atriple2
 let ae1 item amc1 aexpertises
 set atriple2 lput ae1 atriple2

 ask randomsupplier
 [
  set attributes lput (word atriple1 atriple2 ";") attributes
  set attributes lput (word ak0 ";") attributes
  set attributes lput (word ak1 ";") attributes

  if (ak0 >= 3 and ak0 <= 4) and (ak1 >= 3 and ak1 <= 4) [set attributes lput (word "0" ";") attributes]
  if (ak0 >= 3 and ak0 <= 4 and ak1 >= 5) or (ak0 >= 5 and ak1 >= 3 and ak1 <= 4)
  [set attributes lput (word "2" ";") attributes]
  if (ak0 >= 5) and (ak1 >= 5) [set attributes lput (word "1" ";") attributes]
 ]
]

let knowmanufacturer []
let knowapplicator []
let knowsupplier []

ask randomapplicator
[set knowapplicator remove-duplicates aknowledge-fields
 set knowapplicator sort knowapplicator]

ask randommanufacturer
[set knowmanufacturer mknowledge-fields]

let combined-sm-knowledgefields sentence sknowledge-fields knowmanufacturer
set combined-sm-knowledgefields remove-duplicates combined-sm-knowledgefields
set combined-sm-knowledgefields sort combined-sm-knowledgefields

set c-knowledge-overlap 0

let i 0
while
[i < length combined-sm-knowledgefields]
[let svalue item i combined-sm-knowledgefields
 if member? svalue knowapplicator[set c-knowledge-overlap c-knowledge-overlap + 1]
 set i i + 1
]
set attributes lput (word combined-sm-knowledgefields ";") attributes
set attributes lput (word knowapplicator ";") attributes
set attributes lput (word c-knowledge-overlap ";") attributes

set attributes lput (word [who] of randommanufacturer ";") attributes
set attributes lput (word "-" ";") attributes
set attributes lput (word "-" ";") attributes

set attributes lput (word "-" ";") attributes
set attributes lput (word "-" ";") attributes

set attributes lput (word suppliertick ";") attributes
set attributes lput (word acceptance? ";") attributes
set attributes lput (word costs ";") attributes
```

```
  set attributes lput (word sumcosts ";") attributes
  set attributes lput (word implemented? ";") attributes

  file-print attributes
  file-close-all
end

to do-2nd-cooperative-output
  set attributes []
  let filename (word "output-results.txt")
  file-open filename

  set attributes lput (word [who] of randomsupplier ";") attributes
  set supplier-implementation-list lput [who] of randomsupplier supplier-implementation-list
  set attributes lput (word "0" ";") attributes
  set attributes lput (word innovation-rate ";") attributes

  let triple1 []
  let smc0 item 0 smc
  let k0 item smc0 sknowledge-fields
  set triple1 lput k0 triple1
  let a0 item smc0 samounts
  set triple1 lput a0 triple1
  let e0 item smc0 sexpertises
  set triple1 lput e0 triple1

  let triple2 []
  let smc1 item 1 smc
  let k1 item smc1 sknowledge-fields
  set triple2 lput k1 triple2
  let a1 item smc1 samounts
  set triple2 lput a1 triple2
  let e1 item smc1 sexpertises
  set triple2 lput e1 triple2
  set attributes lput (word  triple1 triple2 ";") attributes

  set attributes lput (word k0 ";") attributes
  set attributes lput (word k1 ";") attributes

  if (k0 >= 3 and k0 <= 4) and (k1 >= 3 and k1 <= 4) [set attributes lput (word "0" ";") attributes]
  if (k0 >= 3 and k0 <= 4 and k1 >= 5) or (k0 >= 5 and k1 >= 3 and k1 <= 4)
  [set attributes lput (word "2" ";") attributes]
  if (k0 >= 5) and (k1 >= 5) [set attributes lput (word "1" ";") attributes]

  ask randomsupplier [set attributes lput (word [who] of randomapplicator ";") attributes
  set applicator-implementation-list lput [who] of randomapplicator applicator-implementation-list]

  ask randomapplicator
  [
   let atriple1 []
   let amc0 item 0 amc
   let ak0 item amc0 aknowledge-fields
   set atriple1 lput ak0 atriple1
   let aa0 item amc0 aamounts
   set atriple1 lput aa0 atriple1
   let ae0 item amc0 aexpertises
   set atriple1 lput ae0 atriple1
   let atriple2 []
   let amc1 item 1 amc
   let ak1 item amc1 aknowledge-fields
   set atriple2 lput ak1 atriple2
   let aa1 item amc1 aamounts
```

```
  set atriple2 lput aa1 atriple2
  let ae1 item amc1 aexpertises
  set atriple2 lput ae1 atriple2

  ask randomsupplier
  [
   set attributes lput (word atriple1 atriple2 ";") attributes
   set attributes lput (word ak0 ";") attributes
   set attributes lput (word ak1 ";") attributes

   if (ak0 >= 3 and ak0 <= 4) and (ak1 >= 3 and ak1 <= 4) [set attributes lput (word "0" ";") attributes]
   if (ak0 >= 3 and ak0 <= 4 and ak1 >= 5) or (ak0 >= 5 and ak1 >= 3 and ak1 <= 4)
   [set attributes lput (word "2" ";") attributes]
   if (ak0 >= 5) and (ak1 >= 5) [set attributes lput (word "1" ";") attributes]
  ]
 ]

 let knowmanufacturer []
 let knowapplicator []
 let knowsupplier []

 ask randomapplicator
 [set knowapplicator remove-duplicates aknowledge-fields
  set knowapplicator sort knowapplicator]

 ask randommanufacturer
 [set knowmanufacturer mknowledge-fields]

 let combined-sm-knowledgefields sentence sknowledge-fields knowmanufacturer
 set combined-sm-knowledgefields remove-duplicates combined-sm-knowledgefields
 set combined-sm-knowledgefields sort combined-sm-knowledgefields

 set c-knowledge-overlap 0

 let i 0
 while
 [i < length combined-sm-knowledgefields]
 [let svalue item i combined-sm-knowledgefields
  if member? svalue knowapplicator[set c-knowledge-overlap c-knowledge-overlap + 1]
  set i i + 1
 ]
 set attributes lput (word combined-sm-knowledgefields ";") attributes
 set attributes lput (word knowapplicator ";") attributes
 set attributes lput (word c-knowledge-overlap ";") attributes

 set attributes lput (word [who] of randommanufacturer ";") attributes

 set attributes lput (word "-" ";") attributes
 set attributes lput (word "-" ";") attributes

 set attributes lput (word (SMCV * s-m-customer-value-tolerance) ";") attributes
 set attributes lput (word ECV ";") attributes

 set attributes lput (word suppliertick ";") attributes
 set attributes lput (word acceptance? ";") attributes
 set attributes lput (word costs ";") attributes
 set attributes lput (word sumcosts ";") attributes
 set attributes lput (word implemented? ";") attributes

 file-print attributes
 file-close-all
end

to plotimplementation
 let i 0
```

```
 while [i < length implementation-list]
 [let filename2 (word "implementation-output-results.txt")
  file-open filename2
  let attributes2 []
  let supplier item i supplier-implementation-list
  let applicator item i applicator-implementation-list
  let implemented item i implementation-list
  set attributes2 lput (word supplier ";") attributes2
  set attributes2 lput (word applicator ";") attributes2
  set attributes2 lput (word implemented ";") attributes2
  file-print attributes2
  file-close-all
  set i i + 1]
end

to plotoutput
 let filename (word "last-row-output-results.txt")
 file-open filename

 ask suppliers with [active? = false] [die]

 file-print attributes
 file-close-all
end
```

Appendix C3 Descriptive Statistics

Data set I, response variable *S*

VCM strategy (m)	Newness of innovation (n)	Mean	SD	N
c-VCM	PDI	0.000	0.000	4,220
	FDI	0.692	0.462	11,385
	RNP	0.154	0.361	9,883
	Total	0.369	0.483	25,488
nc-VCM	PDI	0.325	0.468	4,244
	FDI	0.604	0.489	11,359
	RNP	0.504	0.500	10,109
	Total	0.519	0.500	25,712
Total	PDI	0.163	0.369	8,464
	FDI	0.648	0.478	22,744
	RNP	0.331	0.471	19,992
	Total	0.444	0.497	51,200

Data set II, response variable *IT*

VCM strategy (m)	Newness of innovation (n)	Mean	SD	N
c-VCM	FDI	1.934	0.989	7,883
	RNP	4.195	2.712	1,525
	Total	2.301	1.645	9,408
nc-VCM	PDI	4.054	2.266	1,380
	FDI	1.659	0.610	6,862
	RNP	1.670	0.634	5,090
	Total	1.911	1.186	13,332
Total	PDI	4.054	2.266	1,380
	FDI	1.806	0.846	14,745
	RNP	2.252	1.771	6,615
	Total	2.072	1.407	22,740

Data set II, response variable *IC*

VCM strategy (m)	Newness of innovation (n)	Mean	SD	N
c-VCM	FDI	11.674	5.769	7,883
	RNP	14.846	6.502	1,525
	Total	12.188	6.008	9,408
nc-VCM	PDI	14.496	5.916	1,380
	FDI	13.881	6.942	6,862
	RNP	15.489	7.094	5,090
	Total	14.558	6.943	13,332
Total	PDI	14.496	5.916	1,380
	FDI	12.701	6.437	14,745
	RNP	15.341	6.967	6,615
	Total	13.578	6.675	22,740

Data set III, response variable *S*

VCM strategy (m)	Newness of innovation (n)	Knowledge overlap (o)	Mean	SD	N
c-VCM	PDI	Small (+)	0.000	0.000	17
		Medium (++)	0.000	0.000	7,769
		High (+++)	0.000	0.000	24,714
		Total	0.000	0.000	32,500
	FDI	Small (+)	0.000	0.000	12
		Medium (++)	0.162	0.369	3,770
		High (+++)	0.355	0.479	20,313
		Total	0.325	0.468	24,095
	RNP	Small (+)	0.000	0.000	41
		Medium (++)	0.051	0.221	12,753
		High (+++)	0.015	0.122	55,792
		Total	0.022	0.146	68,586
	Total	Small (+)	0.000	0.000	70
		Medium (++)	0.052	0.222	24,292
		High (+++)	0.080	0.271	100,819
		Total	0.074	0.263	125,181
nc-VCM	PDI	Small (+)	0.120	0.326	573
		Medium (++)	0.082	0.274	13,098
		High (+++)	0.024	0.152	8,319
		Total	0.061	0.239	21,990
	FDI	Small (+)	0.347	0.477	262
		Medium (++)	0.391	0.488	11,219
		High (+++)	0.359	0.480	6,343
		Total	0.379	0.485	17,824
	RNP	Small (+)	0.280	0.450	246
		Medium (++)	0.326	0.469	9,305
		High (+++)	0.339	0.473	5,536
		Total	0.330	0.470	15,087
	Total	Small (+)	0.212	0.409	1,081
		Medium (++)	0.253	0.435	33,622
		High (+++)	0.215	0.411	20,198
		Total	0.238	0.426	54,901

(continued)

VCM strategy (m)	**Newness of innovation (n)**	**Knowledge overlap (o)**	**Mean**	**SD**	**N**
Total	PDI	Small (+)	0.117	0.322	590
		Medium (++)	0.051	0.221	20,867
		High (+++)	0.006	0.077	33,033
		Total	0.025	0.155	54,490
	FDI	Small (+)	0.332	0.472	274
		Medium (++)	0.333	0.471	14,989
		High (+++)	0.356	0.479	26,656
		Total	0.348	0.476	41,919
	RNP	Small (+)	0.240	0.428	287
		Medium (++)	0.167	0.373	22,058
		High (+++)	0.044	0.206	61,328
		Total	0.077	0.267	83,673
	Total	Small (+)	0.199	0.399	1,151
		Medium (++)	0.169	0.374	57,914
		High (+++)	0.102	0.303	121,017
		Total	0.124	0.330	180,082