The Role of Corporate Sustainability and Digitalization

in Customer Relationship Management

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Please note: References are provided at the end of each section or research paper, respectively.

Index of Research Papers

This doctoral thesis contains the following five research papers, out of which four are already published or accepted for publication and one is under review for publication:

Research Paper 1:

Buhl HU, Neukirchner M, Pfleger R (2014) What to say and what to do: A Quantitative Model to decide simultaneously on Sustainability Investments and communication of Sustainability Targets. Working paper. Submitted to *Environmental Engineering and Management Journal*

Please note: Paper was rejected in 2015, a reworked version of the paper: Buhl HU, Hosseini S Neukirchner M, Pfleger R (2016) "What to Say and What to Do: How Customer Expectation and Satisfaction determine Sustainability Investments and Communication of Sustainability Targets" is again under review for publication in *Environmental Engineering and Management Journal*

Research Paper 2:

Mueller AL, Pfleger R (2014) Business Transformation towards Sustainability. In *Business Research* 7(2):313-350

VHB-JOURQUAL 2.1: 7.21 points, category B

Research Paper 3:

Pfleger R (2014) Zählen, wiegen, messen – IT Transformationen erfolgreich steuern. In *HMD - Praxis der Wirtschaftsinformatik*, 51(2):164-174

VHB-JOURQUAL 2.1: 5.16 points, category D

Research Paper 4:

Klier J, Pfleger R, Thiel L (2014) Just Digital or Multi-Channel? The Preferences of E-Government Service Adoption by Citizens and Business Users. Accepted for *Internationale Tagung der Wirtschaftsinformatik 2015, Osnabrück*

VHB-JOURQUAL 2.1: 6.73 points, category C

Research Paper 5:

Probst F, Grosswiele L, Pfleger R (2013) Who will lead and who will follow: Identifying Influential Users in Online Social Networks - A Critical Review and Future Research Directions. In *Business & Information Systems Engineering*, 5(3):179-193

VHB-JOURQUAL 2 1: 7.29 points, category B

Please note: Information on copyright and link to access published versions of papers 2 to 5 is given at the end of this dissertation.

I   Introduction

In recent years, companies have been confronted with stagnating markets, an increasing competitive pressure, dwindling resources, new technological developments, and steadily growing customer expectations (Gneiser 2010, Silvius and Schipper 2010). In order to meet the challenges and benefit from possibilities that arise with these trends of our ever-changing environment, companies need to take care of several aspects. First, along with Freeman's stakeholder theory (Freeman 1984), the orientation towards the value driver customer became a central success factor for corporate activities. Accordingly, there has been a shift from maximizing short-term transactions towards building valuable long-term customer relationships (Arndt 1979, Bagozzi 1974, Dwyer et al. 1987). Customers have been placed at the center of corporate strategy (Martin 2010), knowing that they are the basis of company profitability (Gupta et al. 2004, Hogan et al. 2002). Thereby, (value-based) *Customer Relationship Management* (CRM), being understood as a business strategy that focuses on building profitable long-term relationships with customers (Berger and Nasr 1998, Payne and Frow 2005, Shankar and Malthouse 2006, Xu et al. 2002), links concepts and methods from marketing, financial management, and information management to foster customer relations as an important intangible asset and part of companies' value chain (Völckner and Pirchegger 2006). Second, the rise of ethical consumerism (Devinney et al. 2009) along with dwindling resources force companies to increasingly integrate sustainability issues in their business strategy, processes and products. In this doctoral thesis, the attempt towards reducing negative externalities and increasing positive externalities in the mutually dependent social, environmental, and economic dimensions of sustainability is thereby subsumed under the term *Corporate Sustainability* for a business context. Third, new technological developments, such as Web 2.0 technologies enable new ways for customer interaction (Reinhold and Alt 2012) and at the same time provide a large amount of data about (potential) customers, companies need to get under control (Marton et al. 2013, van der Aalst 2013). Thereby, *Digitalization,* describing "an emerging business model that includes the extension and support of electronic channels, content and transactions" (Gartner IT Glossary 2014) is not new in terms of storing, communicating, or computing information (Hilbert und López 2011). However, relatively new are the effects on markets, business models, and organizations. After motivating the three main components of this doctoral thesis, that is, *Customer Relationship Management*, *Corporate Sustainability*, and *Digitalization*, each topic will first be addressed separately. Afterwards, the introduction will end with an integrated view.

Customer Relationship Management places customers at the center of corporate strategy (Martin 2010). In line with the paradigm of value-based management (Coenenberg and Salfeld 2007), the maximization of the long-term sustainable enterprise value has to be seen as guideline for all business activities (Buhl et al. 2011). Accordingly, to contribute to business success, also customer relationships need to be constantly and actively managed (Berger et al. 2002, Doyle 2000, Hogan et al. 2002). Thereby, a suitable financial customer metric to quantify the value of customer relationships is the Customer Equity (CE). It is defined as "the total of the discounted lifetime values summed over all of the firm´s current and potential new customers" (Rust et al. 2004, p. 110) with the Customer Lifetime Value (CLV) as "the present value of all future profits generated from a customer" (Gupta and Lehmann, 2003, p. 10). It is one of the most important key figures in customer value analysis and an established evaluation method in practice (Berger and Nasr, 1998). As not all customers may contribute equally to companies' success, or even have a negative impact (Ang and Taylor 2005, Reinartz and Kumar 2000), a differentiated CRM is needed. One can find several definitions of CRM in literature, focusing on different aspects like strategy, processes, or technology. However, Payne and Frow (2005, p. 168) provide a comprehensive definition, by stating that CRM is "[…] a strategic approach that is concerned with creating improved shareholder value through the development of appropriate relationships with key customers and customer segments. CRM unites the potential of relationship marketing strategies and IT to create profitable, long-term relationships with customers and other key stakeholders. CRM provides enhanced opportunities to use data and information to both understand customers and co-create value with them. This requires a cross-functional integration of processes, people, operations, and marketing capabilities that is enabled through information, technology, and applications". Based on this definition, it is illustrated in Figure I-1, how CRM affects all components of companies, i.e. layers of the enterprise architecture.
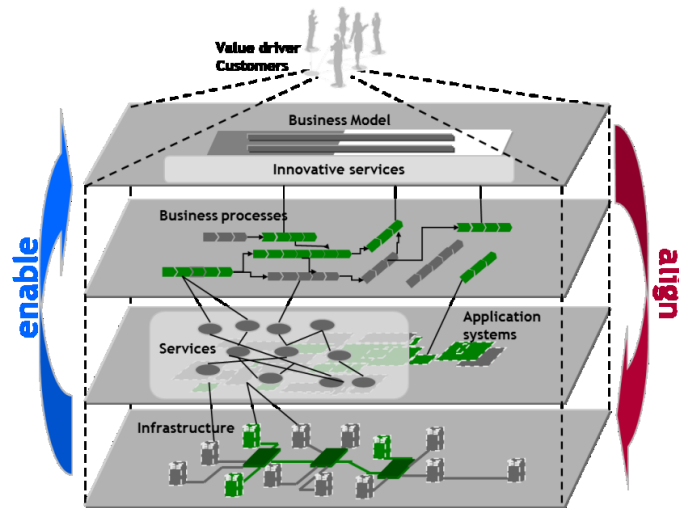
Figure I-1: CRM affects all Layers of an Enterprise Architecture

(following Buhl and Kaiser 2008, p. 47)

Corporate Sustainability has gained remarkable relevance in recent years (Kiron et al. 2012). Besides dwindling resources that are, for instance, related to cost explosions and bottlenecks regarding availability, particularly customer expectations force companies to increasingly integrate sustainability issues (Devinney et al. 2009). Accordingly, business model, underlying processes, services, applications systems, and infrastructure have to be *aligned* towards sustainability (cf. Fig. I-1). When looking at the background of corporate sustainability, one needs to start with sustainability, without the corporate context, being a multidimensional construct itself. Having its origin back in the seventeenth century with a resource-focused, i.e. ecological understanding (overexploitation of forests), the term sustainability has broadened its focus over the last decades. As a wide range of aspects can be subsumed, thus far, there is no globally uniform definition that holds true for all actors and situations (Kastenholz et al. 1996, Koplin 2006, Ruhwinkel 2013). Today's understanding of sustainability is based on the international conferences on environmental issues (cf. "The Limits to Growth" (Clube of Rome 1972), "Our Common Future"/ Brundtland Report (WCED 1987)). The World Commission on Environment and Development (WCED) defined sustainability as a "[…] development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED 1987, Chapter 2, p.1). Sustainability actions can have social, environmental, and economic implications. These three dimensions represent the three main pillars of sustainability and are also known as the "triple-bottom-line" concept (Elkington 1997). This concept and the understanding of sustainability in the Brundtland Report share the belief that sustainable

development requires implementing all dimensions, i.e. all pillars of sustainability equally and at the same time, as they are complementary, but not interchangeable (cf. "strong sustainability", (Figge et al. 2001)). Thereby, the parallel implementation of all dimensions of sustainability can be complementary or rival. As targets in the social or ecological dimension are not necessarily targets from an economic perspective, there may result conflicts, especially in a short-term view. However, these conflicts tend to resolve in the long-run. Ruhwinkel (2013) accordingly concludes that on a high level of aggregation, economic, ecological, and social developments are seen as an inner unity. Nevertheless, the difficulties regarding a clear definition, understanding, and thus operationalization of sustainability show that it is a complex and multidimensional issue, which has to combine efficiency, inter- and intra-generational equity on an economic, social, and environmental foundation (Cieges et al. 2009; Ruhwinkel 2013). Thereby an "either or"-decision as well as the unyielding understanding of concepts like strong sustainability are not sufficient or too inflexible to describe the existing challenges and opportunities within this context.

When looking at *Corporate Sustainability* researchers agree, in accordance with Freeman's stakeholder theory (Freeman 1984) that companies have other responsibilities to their stakeholders besides economic issues (Salzmann et al. 2005). Thereby, sustainability actions should be related to the context of the business, i.e. they should address issues of what is produced (products or services), how it is produced (processes), by whom (people), and its implication for stakeholders (Robinson et al. 2004). However, what is "the financial pay-off" to seek justification for sustainability actions (Salzmann et al. 2005, p. 27)? As the business case of sustainability has gained in importance, companies face a dilemma: In accordance with the paradigm of value-based management, the consideration of costs, benefits, and risks when deciding on an investment is necessary, plausible, and an accepted standard. The same needs to hold true for sustainability context. The economic sustainability perspective thus is of particular importance and can be seen as "ambiguous" in business context. On the one hand, it is one of the three pillars of sustainability. On the other hand, as companies need to follow economic principles to survive in competition and to achieve long-term business success, it emerges as an additional organizational incentive when engaging in sustainability transformations (Seidel et al. 2010). This differentiates the economic dimension from the other two sustainability dimensions.

To differentiate from competitors and ensure continuity of business operations, by considering ecological and societal limits (Ruhwinkel 2013), sustainable CRM brings economic, environmental, and social sustainability issues into the core areas of CRM, i.e. the marketing,

sales, and services processes (Müller 2014). Thereby, *Digitalization* can help being sustainable: New forms of customer communication or interaction, e.g. via online channels like Online Social Networks (OSN) complement or substitute conventional communication forms, e.g. by letter, which reduces paper consumption and waste for example (ecological sustainability dimension). Moreover, meeting customer expectations regarding a multichannel presence and with this generating competitive advantages, for instance, adds to the economic sustainability dimension. *Digitalization*, being an *enabler* (cf. Fig. I-1), can thus help businesses to benefit from new technological developments, and by this, redefines market success factors, further empowers customers, and creates new corporate opportunities (Gray et al. 2013).

In this context, electronic services (e-services) for example, providing information to and allowing bidirectional communication and transactions between companies and customers, have gained increasing importance over the last years (cf. HVB 2014, United Nations 2012). Furthermore, the popularity of another online channel, Social Media (SM), has risen tremendously and revolutionized the ways of communication and interconnectedness of people around the globe (Reinhold and Alt 2012). Along with this development, user-generated content like word-of-mouth published in SM like OSN or blogs have become one of the most important sources of information for consumers' purchase decisions (Kurniawati et al. 2013, Mangold and Faulds 2009, Tripp and Grégoire 2011). Thereby a high percentage of today's consumers trust their friends', acquaintances', or other consumers' opinions instead of traditional forms of advertisement (Chen and Xie 2008, Iyengar et al. 2011b, Narayan et al. 2011, Schmitt et al. 2011). Companies, particularly in the business-to-customer sector, have thus identified SM as important channel to interact with their existing and potential customer base (Reinhold and Alt 2012). On the one hand, they use SM for product promotions as well as to underpin brand positioning and perception (Fournier and Avery 2011, Gallaugher and Ransbotham 2010, Kurniawati et al. 2013, Laroche et al. 2013, Singh et al. 2010, Wen et al. 2009). On the other hand, SM provide an enormous amount of user data which companies are eager to use in order to customize their products or services (Andriole 2010, Boyd and Ellison 2007, Hoffman and Fodor 2010, Mangold and Faulds 2009, Nambisan and Baron 2007, Reinhold and Alt 2011, Wen et al. 2009). Especially CRM is challenged by this development as traditional ways of business interactions one-way-to-the-customer have transformed into a "complex net of many-to-many conversations" (Mangold and Faulds 2009, Reinhold and Alt 2011, 2012). To target "the right customers" in terms of customers bringing value to the company by adopting and/or diffusing new products and services, identifying influential users

in OSN received a great deal of attention in recent years. *Digitalization* thereby enables companies to use so far unknown technical features and OSN provide unique and vast amounts of user data that have not been available before to reveal "who will lead, and who will follow" (cf. Katz 1957, p. 73, research paper 5).

Summarizing, in order to transform towards sustainability and align the enterprise architecture layers accordingly (cf. Fig-I.1), companies can use the technological possibilities of digitalization as enabler. Nevertheless, ending up with everything being digital is not the right solution. For instance, elderly people that are likely to represent the financially strong customer segment today tend to prefer face-to-face interaction and traditional brick-and-mortar branches, whereas the promising segment of digital natives asks for online channels (Eistert et al. 2013). Moreover, customers' channel preferences can also depend on the context of certain services. Thus, to provide a comprehensive channel offering, companies can pursue an omnichannel strategy, in order to give customers a unified experience across all channels (van Bommel et al. 2014). However, although customers prefer to choose suitable channels themselves, when developing a multichannel strategy, it might not be reasonable from an economic point of view, to provide all channels for all services offered, given that some channel characteristics like costs, product fit, or customer acceptance vary greatly (van Bommel et al. 2014, Peterson et al. 2010).

Figure I-2 summarizes the key components of this doctoral thesis and illustrates the interplay of the challenges of *Corporate Sustainability* and *Digitalization* for the *Management of Customer Relationships*.
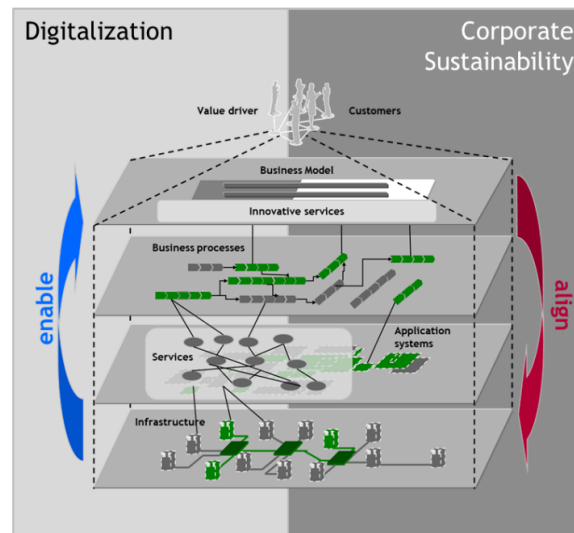
Figure I-2: The Challenges of Corporate Sustainability and Digitalization
for the Management of Customer Relationships (Enterprise Architecture
following Buhl and Kaiser 2008, p. 47)

The following section I.1 introduces the objectives and structure of this doctoral thesis. In the subsequent section I.2, the corresponding research papers are embedded in the research context and the fundamental research questions are highlighted.

I.1   Objectives and Structure of this Doctoral Thesis

The main objective of this doctoral thesis is to contribute to the field of CRM with a particular focus on business transformation towards sustainability and the challenges of a digitalized world for the management of customer relationships. Figure I-3 provides an overview of the objectives and structure pursued in this doctoral thesis.

I   **Introduction**
Objective I.1:   Outlining the objectives and the structure of the doctoral thesis
Objective I.2:   Embedding the included research papers into the research context of the doctoral thesis and motivating the fundamental research questions
II   **Business Transformation towards Sustainability (Research Papers 1, 2, and 3)**
Objective II.1:   Deriving the major factors that influence decisions on sustainability targets and sustainability investment levels from sustainability disclosure literature
Objective II.2:   Developing an approach to determine communicated sustainability targets and sustainability investment levels simultaneously
Objective II.3:   Demonstrating the practicability of the approach using the example of a German beverage company
Objective II.4:   Identifying the field of action for the transformation towards sustainability by structuring an organization's processes along the value chain for the three dimensions of sustainability
Objective II.5:   Developing a decision model to economically evaluate a company's transformation towards sustainability and its operationalization in an example case
Objective II.6:   Emphasizing challenges of (IT) transformation projects and illustrating structure and procedures based on the experience of a transformation project in banking context
Objective II.7:   Deriving key requirements for a successful project management and identifying suitable management dimensions with according key performance indicators to measure project success
Objective II.8:   Challenging proper tool support for project management with regards to standard software and individual solutions
III   **Sustainable Customer Relationship Management in a Digitalized World (Research Paper 4 and 5)**
Objective III.1:   Identifying user preferences regarding channel usage (online and offline) in dependence of the respective services provided
Objective III.2:   Deriving implications for future customer interaction with regards to the challenges and opportunities of digitalization
Objective III.3:   Outlining fundamental research on social influence, influential people and "key users" and their identification in (online) social networks for targeted customer interaction
IV   **Summary and Future Research**
Objective IV.1:   Summarizing the key findings of the doctoral thesis
Objective IV.2:   Highlighting starting points for future research

Figure I-3: Objectives and structure of the doctoral thesis

I.2   Research Context and Research Questions

In the following section, the research papers included in this doctoral thesis are embedded in the research context with respect to the above stated objectives (cf. Fig. I-4). The respective research questions are motivated accordingly.
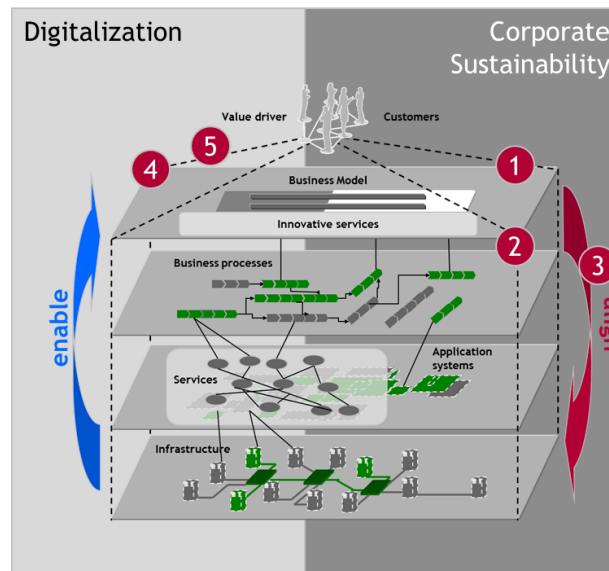

Figure I-4: Research Papers embedded in Research Context
(Enterprise Architecture following Buhl and Kaiser 2008, p. 47)

Customers, the value drivers of companies, demand corporate sustainability, while dwindling resources force it. Companies consequently orientate their business models and underlying architecture layers towards these expectations ("align-perspective"). The research papers in section II focus on different aspects of business transformation towards sustainability. They can be classified along the different layers of the enterprise architecture. Research paper 1 focuses on the interface of customers and the underlying business model, investigating the relationship of customer communication about sustainability and respective investment decisions. Research paper 2 focuses on the business model and its underlying business processes, analyzing how companies can transform towards sustainability and how this can happen in line with economic principles. Research paper 3 concentrates on the transformation itself ("align-perspective"), deriving key requirements for a successful project management, respective key performance indicators, and suitable tool support for steering transformation projects towards sustainability.

The papers embedded in section III deal with the aspects of a sustainable CRM in a digitalized world, focusing on the "enable-perspective" that arises with digitalization. Thereby, research

paper 4 focuses on the demands and preferences of customers in a digitalized world, finding that channel preferences vary with the respective context or complexity of a service. Research paper 5 focuses on the management of customers in the OSN channel and especially on the identification of the most influential users.

I.2.1   Section II: Business Transformation towards Sustainability

Research Paper 1*: "What to say and what to do: A Quantitative Model to decide simultaneously on Sustainability Investments and communication of Sustainability Targets"*

Manifold reasons like the rise of ethical consumerism (Auger et al. 2010) as well as dwindling resources make it necessary for businesses to transform towards sustainability. However, examples show that the credibility of sustainability initiatives is damaged if promised sustainability performance is not achieved. Negative media coverage or customer boycotts (cf. JustAct 2013) are the result of a discrepancy between communicated or pretended sustainability ("greenwashing") and reality. Companies face a dilemma: They are put under pressure to satisfy stakeholder and especially customer expectations on sustainability and thus communicate rather ambitious sustainability targets. At the same time, and in line with value-based management, they have to keep in mind necessary investments for the respective sustainability actions, which puts the economic perspective of sustainability in an ambiguous role in business context. On the one hand, it is one of the three sustainability dimensions. On the other hand however, it emerges as an additional organizational incentive to ensure long-term business success and survival in competitive markets (Devinney 2009, Seidel et al. 2010, research paper 2). To solve this trade-off, a structured approach is needed to set appropriate sustainability targets with respect to customer expectations on the one, and limited financial resources on the other hand. This research paper derives the major factors that influence the decisions on sustainability targets and sustainability investment levels from sustainability disclosure literature. It furthermore develops a formal mathematical approach to determine both communicated sustainability targets and sustainability investments simultaneously. By applying the approach using the example of a German beverage company, the practicability of the approach is demonstrated and managerial implications are derived. In doing so, the research paper addresses the following research questions:

- Which factors influence decisions on sustainability targets and sustainability investment levels?

- How can both communicated sustainability targets and respective sustainability investment levels be determined simultaneously?
- What can be derived from a real world application of the developed approach?

Research Paper 2*: "Business Transformation towards Sustainability"*

In recent years, businesses have recognized sustainability as an emerging mega-trend and as an increasingly important strategic goal. Not only scarce resources and emerging social problems, but also expectations of stakeholders and especially customers intensify the pressure on businesses to integrate sustainability issues in their core processes (Porter and Kramer 2006, Schaltegger and Müller 2008), i.e. business strategy, business model, and the value generating processes and products. In order to make sustainability a "key success factor" (Hahn and Scheermesser 2006), and not only a risk mitigation strategy (Baumgartner and Ebner 2010), a systematic approach is required: To structure the transformation towards sustainability and to steer corporate sustainability comprehensively, companies first need to structure their processes to achieve transparency on where sustainability actions can be incorporated. It is vital to identify where to start implementing sustainability, i.e. concrete possible starting points (corporate activities), what to do, i.e. exemplary sustainability actions, and where these actions have the greatest impact. Possible starting points arise along the value chain of a company and within the three different sustainability dimensions, namely social, economic and ecological dimension. As the transformation towards sustainability is not achieved by single actions, but rather is an ongoing process, decision makers must have means to analyze the current state of an organization. Therefore, this research paper adapts the basic idea of stages of development and maturity (i.e. maturity models) to sustainability context, as a way to capture the progress of sustainability actions within each corporate activity and dimension of sustainability respectively. Taking into account all three aspects (corporate activities, dimensions of sustainability, and sustainability maturity levels), the Sustainability Maturity Cube is developed, which can serve as a blueprint, i.e. a first generic approach of how an organization can structure the field of action for the transformation towards sustainability. With the effects of ecological and particularly social actions being difficult to valuate, decision-makers tend to neglect the economic consequences of these sustainability actions. However, in line with value-based management, the overall economic effect of sustainability actions needs to be considered to ensure long-term business success. The second part of this paper thus deals with the question of how decision makers can economically

evaluate a company's transformation towards sustainability. The developed decision model allows conveying the principles of value-based management to decision making with process models in the context of sustainability. The paper concludes with an exemplary operationalization of the approach. The following research questions are addressed:

- To transform towards sustainability, how can decision-makers structure the field of action along the value chain and in all sustainability dimensions?
- To transform towards sustainability, how should sustainability actions be implemented in accordance with value-based management, i.e., when considering their economic effects?

Research Paper 3: *"Zählen, wiegen, messen – IT Transformationen erfolgreich steuern"*

While the previous research papers add to the layers and interfaces of customers and business model as well business model and underlying processes (cf. Fig. I-4), this research paper concentrates on the challenges of (IT) transformation projects and thus on the "align-perspective". The paper is based on the experience of a transformation project in the banking context. Nevertheless, its results can be transferred to the context of sustainability as the challenges, the key requirements for a successful project management, and related performance indicators resemble those for a business transformation towards sustainability in terms of project characteristics or requirements for its management for instance (cf. Schulte-Zurhausen 2010, Wieczorrek and Mertens 2011).

A business transformation towards sustainability is an ongoing process and affects large parts of companies, e.g. along the value chain and over several sustainability dimensions. This can be explained by the fact, that in order to avoid being accused of greenwashing for example, companies – if deciding for sustainability – need to comprehensively integrate sustainable actions in their business strategy, business model and respective value generating processes and products (Porter and Kramer 2006, Schaltegger and Müller 2008). In order to steer this transformation process successfully it is important to create transparency, e.g. identify and structure the field of action, which is addressed in research paper 2. Moreover, a successful project management is needed, which is addressed in this research paper. After emphasizing the challenges of transformation projects in general, a possible structure is introduced, demonstrating how transformation projects can be organized. Afterwards, the key requirements for a successful project management are derived from practical experience, showing the different demands of different stakeholders within a transformation project. The

experience of the addressed transformation project substantiates the success of a project management that focuses only on a few specific, quantitative performance indicators throughout all release phases of a project. Furthermore, a suitable tool support for project management is considered in this research paper. There exists a broad set of standard software for project management. Nevertheless, the same holds true for individual solutions. A decision for one of these two solutions – standard software vs. individual solution – depends on several factors like already existing tools and knowledge of management in a company, but also costs for licenses, customizing or development of in-house solutions for instance. The experience of the transformation project in this research paper shows that a mixture of standard software and individual solutions often is the best trade-off to benefit from the respective advantages and minimize respective disadvantages at the same time. Summarizing, the following research questions are addressed in this research paper:

- Which challenges exist in transformation projects that are often characterized as "mammoth projects" and how can such projects be structured?
- Which key requirements exist for a successful project management and which management dimensions and key performance indicators are used to fulfill these requirements?
- What is the better project management tool, standard software or individual solutions?

I.2.2   Section III: Sustainable Customer Relationship Management in a Digitalized World

Research Paper 4: *"Just Digital or Multi-Channel? The Preferences of E-Government Service Adoption by Citizens and Business Users."*

Will everything end up being digital in the future? Since the advent of the Internet, the power of information and communication technologies enable delivering an increasing number of services electronically to users, i.e. customers (Heidemann et al. 2013). From 2010 to 2012, e-government for example, being understood as a means to electronically deliver government services to citizens and businesses (Moon and Norris 2005, Patel and Jacobson 2008), grew about 11% worldwide with the highest development in Europe (United Nations 2012). Thereby e-government has evolved in two stages (Reddick 2004, Reddick 2005): The first stage is the information dissemination phase, i.e. pure cataloging of information online for public use. The second stage is transaction based, i.e. service delivery and transactions being

completed online. Both ways of use are also found in the business sector. First, companies started to provide information for customers on their websites, e.g. concerning new offers or products (cf. mobile phone industry) (stage 1). Nowadays, it is possible to use e-services e.g. for making contracts or ordering the relocation of DSL connections when moving to another place (stage 2). However, these actual developments, brought by digitalization, can also be seen from a critical point of view. Does really everything end up being digital in the future or does it need a distinction e.g. regarding different services, their context or their complexity to interact with customers in a sustainable way? This research paper investigates the preferences of e-government service adoption by citizens and business users. Data of 500 citizens and 500 companies (business users) were collected together with the German Federal Employment Agency (Bundesagentur für Arbeit). The results show that user preferences regarding channel usage vary in dependence of the respective services provided. Users ask for a multichannel offering and the possibility to decide themselves, which channel is subjectively suitable for a certain service. With this, the research paper addresses the following research questions:

- What are the preferences of users regarding channel usage for online and offline channels with respect to the respective services provided?
- What implications result of these usage preferences for CRM with respect to digitalization and sustainable customer interaction?

Research Paper 5: *"Who will lead and who will follow: Identifying Influential Users in Online Social Networks - A Critical Review and Future Research Directions"*

One of the most important questions of a sustainable CRM is how companies can target "the right (existing and potential new) customers" in terms of customers bringing value to the company by (1) adopting and/or (2) diffusing new products or services. Against this background, the decreasing impact of traditional marketing techniques (Clemons 2009, Hinz et al. 2011, Trusov et al. 2009) but also the already noted trust of customers in recommendations of other consumers, acquaintances, and friends (Chen and Xie 2008, Moon et al. 2010) explain, why OSN are receiving such a great deal of attention in research and practice in the last years. It is crucial for companies to identify influential people in the crowd and the possibility to do so increased immensely with the explosive growth of OSN. Unknown technical features and large amounts of available data on users, their behavior and their contacts enable identifying influential users within those networks. To profit from their "power" within a network, i.e. the effects of their social influence on product adoption (cf.

Godes and Mayzlin 2009, Goldenberg et al. 2009, Hinz et al. 2014, Iyengar et al. 2011a), more and more companies try to target them explicitly, for example, when placing new marketing messages (Bonchi et al. 2011, Hinz et al. 2011, Libai et al. 2010). However, the development of practical approaches for the identification of influential users in OSN is still at the beginning and numerous challenges exist. This research paper is a state of the art paper, giving an overview on existing publications regarding the identification of influential users in OSN. The paper addresses the following research questions:

- How are influential users characterized in the context of OSN?
- Which approaches have been developed and applied for the identification of influential users in OSN?
- How have these approaches been evaluated and which implications have been derived?

After this introduction, which aims at outlining the objectives and the structure of this doctoral thesis as well as at motivating the research context and formulating the fundamental research questions accordingly, the respective research papers are presented in sections II and III. Subsequently, the key findings are summarized and starting points for future research are highlighted in section IV.

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II   Business Transformation towards Sustainability

The research papers in section II focus on different aspects of business transformation towards sustainability. To meet the expectations of customers as well as to consider the effects of dwindling resources, companies have to integrate sustainability into their strategy, processes, services and products. Thereby, several questions arise that have to be answered. First, companies need to analyze customer expectations and determine both, the respective communication strategy and the necessary investment levels to perform sustainability actions. Second, companies need to structure the field of action, i.e. identify where these sustainability actions can be incorporated, and how they can be implemented considering economic effects. Third, companies need a suitable project management to comprehensively steer the transformation towards sustainability.

The first research paper *"What to say and what to do: A Quantitative Model to decide simultaneously on Sustainability Investments and communication of Sustainability Targets"* develops a decision model to determine the optimal level of both, sustainability investments and communicated sustainability targets. The Kano model is used to model customer satisfaction. An application for the context of a German beverage company shows the practicability of the approach.

The second research paper *"Business Transformation towards Sustainability"* first structures the field of action in order to achieve transparency for decision makers, to determine where sustainability actions can be incorporated. In the second part of the paper, a decision model is developed to analyze how sustainability actions can be implemented in accordance with the paradigm of value-based management, considering their economic effects.

The third research paper *"Zählen, wiegen, messen – IT Transformationen erfolgreich steuern"* emphasizes challenges that exist in transformation projects that are often characterized as "mammoth projects" and proposes how these could be structured. In addition, key requirements for a successful project management are derived and suitable key performance indicators are suggested. The paper ends with a discussion on suitable tool support for project management.

II.1 Research Paper 1: "What to say and what to do: A Quantitative Model to decide simultaneously on Sustainability Investments and communication of Sustainability Targets"

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Abstract:

Due to manifold reasons, it is necessary for businesses to transform towards sustainability and this involves both management and reporting implications for companies. In order to satisfy stakeholders and especially customer expectations on sustainability, companies need to set and communicate targets for improving their sustainability indicators and benefit from achieving related targets. Using the Kano model for customer satisfaction, we develop a decision model to determine the optimal level of both sustainability investments and communicated sustainability targets. We apply the model using real world data of a German beverage company and show how it helps to choose the optimal communication and investment levels while balancing chances and risks with respect to customer satisfaction. It is shown that these levels depend on customer expectations and how customers value promised sustainability targets and achievements.

Keywords: *Sustainability reports, GRI guidelines, Optimization Model, Investment-decision, Target*

II.1.1   Introduction

The rise of ethical consumerism as well as dwindling resources force companies to increasingly integrate sustainability issues into their business models. In this paper we understand sustainability as an attempt towards reducing negative externalities and increasing positive externalities in the mutually dependent social, environmental, and economic dimensions. Thereby, and in line with the paradigm of value-based management, the economic dimension has an ambiguous role in business context. One the one hand, it is one of the three sustainability dimensions; at the same time however, it emerges as an additional organizational incentive to ensure long-term business success and survival in competitive markets (Müller and Pfleger 2014, Seidel et al. 2010). Devinney (2009) addresses this conflict, focusing on Corporate Social Responsibility (CSR) and manifests that "corporations, by their nature, have conflicting virtues and vices that ensure that they will never be truly socially responsible by even the narrowest of definitions" (Devinney 2009, p. 45/46). Corporate sustainability or CSR thus by nature are an oxymoron (Devinney 2009) and will always lead to trade-offs. Nevertheless, facing those challenges and judge about "what is "better" or "worse"" (Devinney 2009, p. 46) is preferable than remaining inactive at all. Consequently, companies need to strive towards integrating sustainability issues into their business models, finding the best trade-off between the likely rivaling dimensions. This holds particularly true for conflicts between social or ecological measures and resulting economic burdens.

Examples show that the credibility of sustainability initiatives is damaged if a promised sustainability performance is not achieved. The discrepancy between promised sustainability and being involved in an environmental or social catastrophe is, for instance, evident for the oil and gas company BP as well as the textile company Mango. On the one hand, BP pursued a green rebranding strategy in 2000 (Green 2002) and communicated in their sustainability report the aim for "no accidents, no harm to people and no damage to the environment" (BP 2009, p. 2). However, BP decided in favor of cost savings rather than ensuring well-safety which lead to the environmental disaster of the Deepwater Horizon oil spill in 2010 (Daly and Henry 2010). BP was denounced of greenwashing and suffered immense loss of trust, revenue and share price (Esch and Weyler 2010). Similarly, a report published by the Clean Clothes Campaign (Foxvog et al. 2013) revealed that Mango had clothes manufactured at garment shops in Bangladesh, where 1,129 people died due to the collapse of the Rana Plaza building in 2013. Prior, Mango stated to verify that manufactures adhere to Mango's code of conduct for manufacturers and to quit business relationships in case of non-compliance (Mango 2012). Following this disaster, the social media protests led by JustAct (2013) promoted a brand

boycott and claimed compensation for victims. Even in the absence of extreme situations a company's image suffers if promised sustainability performance is not achieved. The German meat producer Wiesenhof for example promotes 100% natural meat, from animals breeding in Germany ("Wissen was drin ist"), but all again ended up several times, being accused of disastrous conditions at its respective suppliers (Hucklenbroich 2011). These examples illustrate that companies which communicate and pretend to be sustainable on the one hand but fail to achieve sustainability targets on the other hand, experience negative media coverage and customers may boycott their products. These effects can lead to considerable damage of reputation and hence heavy financial losses at the end. Accordingly companies would like to promise rather conservative progress in sustainability so that an achievement of the communicated sustainability targets is ensured with high probability.

Moreover, due to a greater transparency, e.g. induced by IT progress, discrepancies in communicated sustainability targets and respective achievements (e.g. the breeding of organic turkey under circumstances of factory farming (Ermakow and Fehlhaber 2012) generally come to light more often. At the same time, customers get more sensitive regarding sustainability issues. Tools like Sourcemap (www.sourcemap.com), for instance, can visualize the supply chain of a product or for a whole company. Thus, especially in the context of sustainability, customers gain more and more insights into the core processes of a company. Thereby, the provided transparency offers customers the possibility to track the origin of products (i.e. where do things come from). Furthermore, labels such as "fair trade" or organic certifications assure that e.g. the production of a certain product fulfills all requirements regarding sustainability standards (i.e. how things are made). This increased transparency makes customers more and more aware of corporate misbehavior. Moreover, customers question whether companies fulfill their corporate responsibility and base their buying decisions thereon (Auger et al. 2003; Auger et al. 2008; Auger et al. 2010; Collins et al. 2007). At the forefront of this behavior we find so-called "LOHAS" customers (Lifestyle of Health and Sustainability) (Ray and Anderson 2000). Customers of this market segment strive for sustainable living and consumption (Symposium Sustainable Consumption 1994; Paterson 2008). Consequently LOHAS are particularly critical regarding the social, environmental, and economic impact of their living and consumption. According to an Ernst & Young study (Schüpbach et al. 2007) in Switzerland, LOHAS customers are well informed about ethical and social aspects of the products they consume. 90% of those customers would switch to another brand if they discovered corporate misbehavior and 77% state that they are willing to pay a premium for organic products (Schüpbach et al. 2007). In developed countries like

Switzerland LOHAS might develop to a dominating lifestyle, which could lead to a market share of organic products of 25% by 2020 (Schüpbach et al. 2007). As such sustainability oriented customers take into account a company's sustainability performance, companies are put under pressure to communicate rather ambitious sustainability targets to customers (Auger et al. 2010; Devinney et al. 2006). Besides developing risk mitigation strategies, companies become increasingly aware of the economic benefits of incorporating sustainability into their business practices (Auger et al. 2010; Ramirez 2013) and try to obtain a competitive advantage in the market place. As a study undertaken by MIT Sloan Management Review shows (Krion et al. 2012), two thirds of the respondents say that sustainability was necessary for being competitive in today's marketplace. Nearly a third of the respondents reply that their sustainability activities do contribute to their profitability. Fisman et al. (2008) state that sustainability can be a signal for product quality in competitive markets. Additionally, empirical research supports a positive link between sustainability and firm value (Auger et al. 2003; Auger et al. 2008; Auger et al. 2010; Berman et al. 1999). More general, Schäfer (2006) states that the main incentives for companies to engage in sustainability are a better corporate image, an improved awareness of risk, and innovation. In summary, customers expect companies to do business in a sustainable way and companies see this expectation as one reason to engage in sustainable business practices.

Companies therefore face several challenges in order to avoid being accused of greenwashing and risking similar failures such as BP or Mango. First of all, the business case for sustainability is missing for several sustainability initiatives. The cost side of sustainability reporting, for example, can be determined whereas the benefits and returns can only vaguely be estimated. Additionally, companies need to figure out which sustainability initiative gives them most benefits, for instance, to choose one or rank several alternatives given a budget constraint. Further they need to actively manage how customers perceive their sustainability image. As a result companies need to balance the chances of customer expectations on high sustainability achievements (expected to result in higher sales) against the risks of breaking high promises. In other words a company must set as ambitious sustainability targets as possible with respect to customer expectations on the one hand, but in line with value-based management, has to keep in mind the needed investments (ambiguous role of economic perspective) to achieve those communicated targets on the other hand. As an open research gap we find out that there is no structured way yet to set appropriate sustainability targets with respect to customer expectations on the one and limited financial resources on the other side. In order to solve the aforementioned trade-off we develop a formal-mathematical model. We

approach this research gap by a simultaneous optimization of both, sustainability targets and the according sustainability investment level while taking into account customer expectations and customer satisfaction for sustainability indicators.

In conclusion the contributions of this paper are: we derive the major factors that influence the decisions on sustainability targets and sustainability investment levels from sustainability disclosure literature (Section 2). We develop an approach to determine both, communicated sustainability targets and sustainability investment levels simultaneously (Section 3). Additionally, we demonstrate the practicability of our approach by using the example of a German beverage company (Section 4). After that, we derive managerial and research implications and critically discuss the limitations of our work (Section 5). Finally, we provide a brief summary of our research (Section 6).

II.1.2   Sustainability Reporting and its Effects on Customer Satisfaction

Sustainability reporting is an established instrument to communicate corporate sustainability (Starbuck et al. 2013). A KPMG (2011) study revealed that already 95% of the largest 250 global companies publish a stand-alone sustainability report. Companies thereby disclose information about their social, environmental, and economic impact. Although different reporting guidelines have emerged (e.g. OECD Guidelines for Multinational Enterprises (OECD 2011), UN Global Compact "Ten Principles" (United Nations Global Compact 1999)), the Global Reporting Initiative´s G4 Sustainability Reporting Guidelines (GRI-guidelines) are the most comprehensive and recognized standard (Brown et al. 2009; Global Reporting Initiative 2013). They request companies to position themselves on how they approach sustainability. The GRI-guidelines consist of an implementation manual, reporting principles, and standard disclosures to establish standardized, transparent, and consistent reporting. Companies are asked to disclose their sustainability performance on 9 economic, 34 environmental, and 48 social sustainability indicators. 75 of these 91 sustainability indicators require quantitative information.

Various research activities focus on the quality of a company´s sustainability reporting (Freedman and Wasley 1990; Iatridis 2013; Marshall et al. 2009; Patten 2002; Quick and Knocinski 2006). An important criterion for quality evaluation is whether quantitative data is reported, as this enables comparisons over time as well as benchmarks. The Wiseman (1982) Index for instance, focuses on the evaluation of environmental disclosure. The index assigns a score to different reporting aspects depending on how specific the reporting is and whether quantitative data was disclosed. Clarkson et al. (2008) develop an index which weighs hard

disclosures, such as quantitative data, more heavily than soft disclosures. Examples for quantitative indicators of the GRI-guidelines are the "financial implications […] for the organization´s activities due to climate change" (EC2), the "energy indirect greenhouse gas emissions" (EN16) or the "[…] rates of injury" (LA6). According to further explanations in the GRI-guidelines, those indicators shall be reported on company level and not on a product-specific level. The research firm Centre for Australian Ethical Research goes one step further and highlights the importance of measuring performance against targets as a criterion for reporting quality (Australian Government 2005). This requirement is also in line with Biedermann (2008) who states that corporate sustainability needs to be linked to targets in order to avoid criticism of PR-talk. To address this issue, companies should set specific targets for single sustainability indicators and, since implementing sustainability is an ongoing process, track them on a regular basis in order to document progress. The brewing company Heineken for example has a section on "what we said and what we´ve done" in their sustainability report which lists targets and achievements on a sustainability indicator level (Heineken 2011). After one reporting period, achievements are compared with the respective targets and an evaluation of the company's performance is possible. The communication of specific targets and achieved progress thus can signal a strong commitment towards sustainability and helps to avoid potential criticism beforehand.

Because companies are aware of the need to report on sustainability and especially of doing this based on quantitative indicators, they question which information to disclose and which targets to communicate in sustainability reports. Several studies have empirically analyzed factors that influence sustainability and especially environmental disclosure strategies. Roberts (1992) and Huang and Kung (2010), for example, find out that the pressure by customers and their demands are a major factor determining the extent of the social or environmental disclosure of companies. Many papers find a positive link between sustainability disclosure, environmental performance, and financial performance (Iatridis 2013; Meng et al. 2013). However, there exist only few approaches for determining specific sustainability targets. One example is Rauch and Newman (2009) who define sustainability metrics targets for Yale University. Starting from national goals, e.g. greenhouse gas reduction targets, the authors scale those targets according to university population size and the share of emissions attributable to the educational sector. Although the link between national and institutional targets is well established in this approach, the targets are set without consideration of customer expectations and are not linked to limited financial resources (economic dimension), needed for the investment. To the best of our knowledge, thus far there

exists no structured approach to setting targets on a sustainability indicator level for companies, considering customer expectations, while having limited financial resources in mind. In order to make decisions on both factors, what sustainability targets to communicate and what sustainability investments to undertake on a company level, one has to consider the economic effects of communicated sustainability targets and the respective sustainability performance, i.e. one needs to quantify customer reactions on sustainability investments.

In this regard, Brown and Dacin (1997) find that a company's sustainability activities and the corresponding associations of customers affect purchasing decisions. Furthermore, they show that customers evaluate products inferior, if they have negative sustainability associations with a company in general and vice versa. Accordingly, Servaes and Tamayo (2013) as well as Auger et al. (2010) conclude that sustainability is a product attribute that customers value if they are informed about it. This idea is also supported by findings of a corporate social responsibility (CSR) study (Cone Communications and Echo 2013, p. 20) saying that 91% of respondents "are likely to switch brands to one that is associated with a good cause, given similar price and quality". However, in order to be influenced in their purchasing decisions, customers need to be informed regarding sustainable or unsustainable corporate behavior (Brown and Dacin 1997; Creyer 1997). In this case, information either flows directly from a company to the customer, e.g. in form of a sustainability report or indirectly through media response (Fifka 2013). Taken together customers perceive a company´s sustainability performance, as for example specified by the GRI-guidelines, as a product attribute (Auger et al. 2010). Whether customers positively or negatively evaluate a company´s sustainability performance, however, depends on their expectations. From an economic point of view, it is therefore not sufficient to set targets solely with regard to national goals or regulatory requirements. Instead, an economic approach is necessary to set sustainability targets considering customer behavior as well as limited financial resources.

In order to better understand how customers value the performance concerning a product attribute, for instance the Kano model for customer satisfaction (Kano et al. 1984) can be used. This model explains how the fulfillment of customer expectations regarding a product attribute determines customer satisfaction. Considering the sustainability performance of a company as a product attribute (aggregation of the performance over all sustainability indicators), one can use the Kano model to determine the influence of sustainability targets and sustainability investments on customer satisfaction. Here, customer satisfaction is determined by the confirmation/disconfirmation paradigm (c/d-paradigm). This method proposes that customer satisfaction results from a "nominal-actual comparison", where the

"actual" value is the perceived quality of a product or performance of a product attribute, and the "nominal" value is a standard of comparison and constitutes customer expectation or confirmation level. Customer expectations are subjective and individual for every customer. They are influenced and formed by various factors such as customer's needs, former experiences, or industry and regulatory standards. If a product attribute over-fulfills the expectations of a customer, i.e. the product attribute is above a customer's confirmation level, it generates customer satisfaction. Vice versa, staying behind a customer's expectations leads to disappointment. Hölzing (2008) states that customers can be satisfied or not-satisfied with single product attributes and overall customer satisfaction is determined by the sum over all partial evaluations. In order to determine overall customer satisfaction, there exist three categories according to Kano et al. (1984), product attributes can be assigned to, i.e. must-be, one-dimensional, and attractive attributes. Must-be attributes are considered as fundamental and natural by the customer. If not fulfilled, customer dissatisfaction results. However over-fulfilling will not increase customer satisfaction as must-be attributes are perceived only implicitly. One-dimensional attributes generate both, customer satisfaction and dissatisfaction in dependence of an attribute's over- or under-fulfillment. Thereby an over- or under-fulfillment of expectations leads to a proportional increase/decrease of customer satisfaction (linear relationship). The customer is aware of one-dimensional attributes and explicitly demands them. Attractive attributes are not expected by the customer though. An over-fulfillment of customer expectations thereby leads to a disproportional increase of satisfaction. Under-fulfillment, however, will not cause dissatisfaction, as the customer does not expect the attribute (Moser et al. 2013). We classify the sustainability performance of a company as a one-dimensional attribute, which is expected and explicitly demanded by customers. Customers value an over-fulfillment, leading to an increased customer satisfaction, which for instance, can lead to higher retention rates or the acceptance of higher prices for sustainably produced products (cf. Auger et al. 2010; Servaes and Tamayo 2013). At the same time, customers punish the under-fulfillment of sustainability performance, leading to dissatisfaction, e.g., by boycotting a brand (cf. Ermakow and Fehlhaber 2012; Esch and Weyler 2010). Whether the performance regarding sustainability leads to satisfaction or dissatisfaction thus depends on the extent of over- or under-fulfillment of customer expectations. Figure II-1.1 shows the different kinds of product attributes suggested by Kano et al. (1984) and how they determine customer satisfaction.
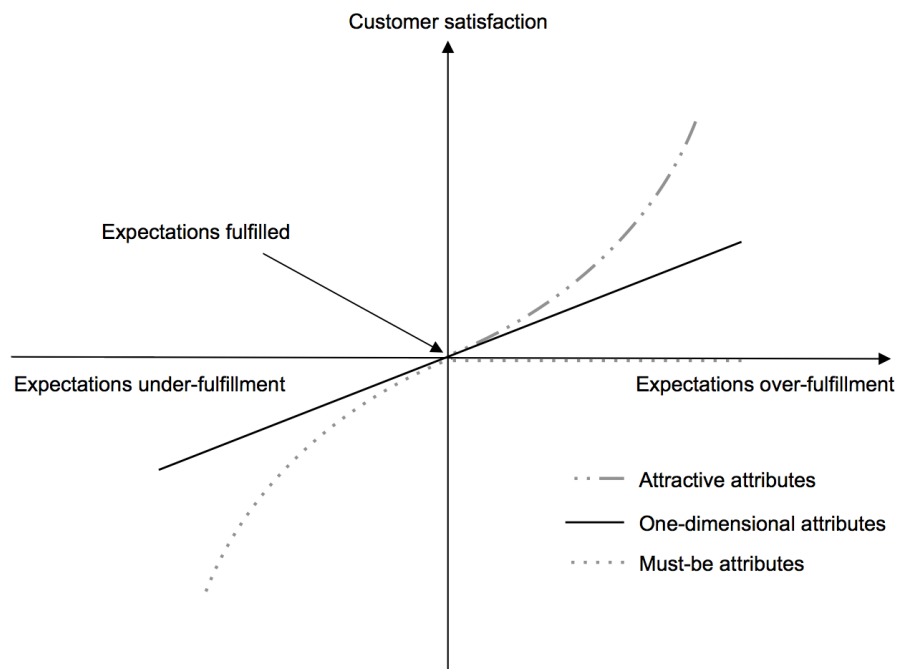
Fig. II-1.1 Determinants of customer satisfaction following the Kano model (Moser et al. 2013)

In summary, companies need to set sustainability targets and report the actual achievement of these targets in order to document their sustainability performance. However, to the best of our knowledge, there exists no approach to setting such sustainability targets while considering customer expectations and limited financial resources yet. Because customers perceive sustainability performance as a product attribute, the Kano model and in particular the characteristic of one-dimensional attributes can be used to analyze its effect on customer satisfaction. Therefore we develop a mathematical model to determine the optimal sustainability targets and sustainability investments for sustainability indicators in the next section.

II.1.3   Approach to Deriving the Economic Optimal Sustainability Targets and Sustainability Investment Levels

To derive both the economic optimal sustainability targets and sustainability investment levels, we develop a formal mathematical approach. For this purpose, we consider the additionally generated cash inflows resulting from customer satisfaction caused by sustainability targets and achievements and subtract the corresponding efforts. We consider a company that wants to communicate a sustainability target for a quantitative sustainability indicator and needs to make the according investment decision in order to improve the indicator level. The communicated sustainability target $Z \in \mathbb{R}$ reveals the absolute indicator consumption $L \in \mathbb{R}$ a company promises to achieve and communicates to customers. If for

example the current absolute CO_2-emissions of a company are 60,000 tons and a company wants to reduce those CO_2-emissions by 10% over one reporting period, a sustainability target Z of 54,000 tons would be communicated to customers. In this relationship, the absolute indicator consumption L then shows the actually achieved value, e.g. the absolute amount of CO_2-emissions at the end of one reporting period, whereas Z shows the ex ante communicated consumption the company aims for. Communicated sustainability targets and sustainability investment levels need to be optimized simultaneously, as the credibility of sustainability initiatives is highly linked to the achievement of communicated targets. Consequently companies would like to set rather conservative targets so that the communicated targets are achieved with high probability. Nevertheless companies are also put under pressure to communicate rather ambitious targets since customers have certain expectations on a company's sustainability performance. In consequence a company must set as ambitious targets as possible with respect to customer expectations on the one hand but has to keep in mind the needed investments to achieve those communicated targets on the other hand. This trade-off requires a simultaneous optimization of both, sustainability targets and the according investment level. Therefore we make the following assumptions:

A.1 The absolute indicator consumption L is a random variable which depends on the output quantity $X \in \mathbb{R}_0^+$ and on the specific indicator consumption per output unit $d \in \mathbb{R}$.

$$L = Xd \sim u.d.\,[Ad; Bd] \qquad\qquad (3.1)$$

The output quantity X is a random variable and is assumed to be uniformly distributed (u.d.). The output is random because it can decline, for example, in times of recession or rise due to increased demand. The output quantity $A \in \mathbb{R}_0^+$ represents the minimum level for the output quantity, whereas the output quantity $B \in \mathbb{R}_0^+$ represents the maximum level, with A<B. For the quantitative sustainability indicators in focus, a company is able to evaluate how many units of the corresponding sustainability indicator are needed to produce one output unit. By the use of this specific indicator consumption per output unit d, the absolute indicator consumption L can be calculated. At this point it is debatable whether reporting on sustainability indicators should be executed on a relative or an absolute basis. The Coca-Cola Company for example reports its CO_2-footprint per liter of product (The Coca-Cola Company 2013). In this context a company might improve on a relative basis, but increases its negative environmental impact in absolute terms by increasing production quantities. From a strong

sustainability perspective (Figge et al. 2002) however, reporting on a relative basis is not sufficient. This also corresponds with the idea of the GRI-guidelines stating that the absolute economic, environmental, and social impact for a reporting period should be reported on a company level and be used for the assessment of a company's sustainability performance. Thereby, this absolute consumption is not a deterministic figure set by a company, but is fraught with risk. The actual absolute indicator consumption, which a company achieves, is influenced by various risk factors such as operations, sales, and financial risk. Operational risks are manifold and include technology, internal process, staff or external risks (Faisst and Kovacs 2002). Since the absolute indicator consumption is highly linked to the output quantity a company produces, we consider the variation of the output quantity as the main risk factor for achieving sustainability targets. For a decreasing (increasing) output quantity the overall indicator consumption decreases (increases) as well. This is a simplification that might not be appropriate for all quantitative sustainability indicators but should be understood as one way to express the risk of the unsecure absolute indicator consumption of sustainability indicators.

A.2 A company is able to improve the specific indicator consumption d up to the technological feasibility $h \in [0;1]$ through an investment $I \in \mathbb{R}^+$ and accordingly may improve the absolute indicator consumption.

$$L(m) = Xd(1 - mh) \sim u.d.\,[Ad(1 - mh);\ Bd(1 - mh)] \qquad (3.2)$$

A company makes a decision on the intensity of an investment I which is represented by the investment level $m \in \mathbb{R}_0^+$. The investment level m is standardized to the range of $[0;1]$. For the investment I the property of arbitrary divisibility holds true. In this context $m_{max}=1$ means that investment I is fully executed. An investment level $m_{min}=0$ means no investment I is undertaken. Even though a company can make the full investment I to improve a sustainability indicator, there is a technological limit for improvement. The technological feasibility h specifies to what extent companies can improve a sustainability indicator if the full investment I is made. The technological feasibility h is an exogenous variable and is standardized to the range of $[0;1]$.

A.3 Customer satisfaction results on a communication level $S_{com} \in \mathbb{R}$ and on an achievement level $S_{ach} \in \mathbb{R}$.

$$S_{com}(Z) = g_1(V - Z) \qquad (3.3)$$

$$S_{ach}(m, Z) = g_2(Z - L) = g_2[Z - Xd(1 - mh)] \tag{3.4}$$

Customers have a certain expectation $V \in \mathbb{R}$ for the absolute indicator consumption L of a company. The variable V is exogenously given and is influenced by numerous factors such as customer experiences, culture, industry standards or regulatory requirements (Cho et al. 2013). In this context customer satisfaction or dissatisfaction emerges from a twofold comparison. First, customers compare the communicated target level Z with their expectations V leading to confirmation or disconfirmation on a communication level. Second, customers compare the achieved absolute indicator consumption L to the communicated target level Z leading to confirmation or disconfirmation on the achievement level. The fact that both, communication and achievement level affect customer satisfaction leads to a trade–off. On the communication side ambitious targets (i.e. low values for Z, meaning low CO_2-emissions for example) should be communicated in order to increase the difference between customer expectations and firm targets. In contrast, on the achievement level more ambitious targets (i.e. low values for Z) make it harder to generate customer satisfaction, as higher investments (i.e. high values for m) are required to achieve the communicated targets at the end of one reporting period (i.e. low values for L). How important the communication or achievement level is, depends on the individual customer and is expressed by weights $g_1 \in \mathbb{R}_0^+$ for the communication level and $g_2 \in \mathbb{R}_0^+$ for the achievement level, with $g_1+g_2=1$. Since customer satisfaction S_{ach} is derived from a linear transformation of the random variable X (cf. valuation on an absolute basis), S_{ach} can as well be perceived as a random variable (Mosler and Schmid 2011) with the density function $f(S_{ach})$:

$$S_{ach}(m, Z) \sim u.d.\,[g_2 Z - g_2 Bd(1 - mh); g_2 Z - g_2 Ad(1 - mh)] \tag{3.5}$$

$$f(S_{ach}) = \frac{1}{g_2 d(1 - mh)(B - A)} \tag{3.6}$$

A.4 A company´s additional revenue equals the generated customer satisfaction S_{com} and S_{ach} multiplied by a conversion factor $w \in \mathbb{R}_0^+$ for positive customer satisfaction and a conversion factor $\hat{w} \in \mathbb{R}_0^+$ for negative customer satisfaction.

Customer satisfaction leads to customer loyalty, which leads e.g. to customer retention and reduced price sensitivity, and thus to improved financial results (Stock 2002). Accordingly, Mittal et al. (2005) show that the link between customer satisfaction and financial performance is positive. Since this multi-staged and complex effect chain is not the focus and core of this approach, we use the conversion factor w to simplify the correlation of customer satisfaction and a company´s revenue. The prospect theory (Kahneman and Tversky 1979) which states that customer disappointment outweighs customer enthusiasm thereby explains the split up of the conversion factor. Positive (negative) customer satisfaction S_{com} or S_{ach} is multiplied by the conversion factor w ($\hat{w}$), with $w < \hat{w}$. In consequence the conversion factor w ($\hat{w}$) expresses the monetary valuation (gain/loss) per unit of customer satisfaction (dissatisfaction). The conversion factors w and $\hat{w}$ are exogenous variables. They depend on the respective company and the applied sustainability indicator, respectively. Using this simplifying relation we can formalize a company´s expected revenue $R(m,Z) \in \mathbb{R}$. We use the characteristic function $\mathbf{1}$ in formula (3.7) to make sure that positive customer satisfaction S_{com} or S_{ach} is multiplied by w and negative customer satisfaction S_{com} or S_{ach} is multiplied by $\hat{w}$[1]:

$$R(m,Z) = \mathbf{1}_{(-\infty;o]}(V-Z)S_{com}\hat{w} + \mathbf{1}_{(0;\infty)}(V-Z)S_{com}w + \qquad (3.7)$$

$$\frac{1}{g_2 d(1-mh)(B-A)}\left\{\mathbf{1}_{(-\infty;o]}\left(g_2 Z - g_2 Bd(1-\right.\right.$$

$$\left.mh)\right)\int_{g_2 Z - g_2 Bd(1-mh)}^{0}\hat{w}\,S_{ach}\,dS_{ach} + \mathbf{1}_{(0;\infty)}\left(g_2 Z - g_2 Bd(1-\right.$$

$$\left.mh)\right)\int_{g_2 Z - g_2 Bd(1-mh)}^{0}w\,S_{ach}\,dS_{ach} + \mathbf{1}_{(-\infty;o]}\left(g_2 Z - g_2 Ad(1-\right.$$

$$\left.mh)\right)\int_{0}^{g_2 Z - g_2 Ad(1-mh)}\hat{w}\,S_{ach}\,dS_{ach} + \mathbf{1}_{(0;\infty)}\left(g_2 Z - g_2 Ad(1-\right.$$

$$\left.\left.mh)\right)\int_{0}^{g_2 Z - g_2 Ad(1-mh)}w\,S_{ach}\,dS_{ach}\right\}$$

A.5 The key objective of a company is to maximize its profit $P(m,Z) \in \mathbb{R}$. The time value of money is neglected.

It is reasonable to neglect the time value of money, since the communicated sustainability targets and achievements do hold for one reporting period only. Further, we differentiate three expense blocks to specify the expense side C to execute an investment for improving sustainability indicators and to communicate sustainability targets. First we have fixed expenses $K_{fix} \in \mathbb{R}^+$ to put the investment I for improving a sustainability indicator into action.

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[1] We pursue an alternative model in annotation 1 without any distinction of cases to derive analytical optima for Z_{opt} and m_{opt}.

These fixed expenses K_{fix} are due if the investment is started ($m > 0$) and are independent of the sustainability investment level m and sustainability target Z. Second we have to consider variable expenses $k_{var} \in \mathbb{R}^+$ which depend on the sustainability investment level m. We assume a quadratic relation between the sustainability investment level m and the variable expenses k_{var}. Third, expenses for the communication of the sustainability target Z have to be considered. These communication expenses $K_{com} \in \mathbb{R}^+$ are independent of the communicated sustainability target Z and sustainability investment level m, and are due if the sustainability target is communicated to customers. In consequence, for $m>0$ and $Z>0$, the expense side $C(m) \in \mathbb{R}^+$ results as:

$$C(m) = K_{fix} + m^2 k_{var} + K_{com} \tag{3.8}$$

Postulating these assumptions we aim to derive the optimal communicated sustainability target Z_{opt} and sustainability investment level m_{opt} for sustainability indicators. A company considers the additionally generated cash inflows through customer satisfaction caused by sustainability objectives and achievements and subtracts the corresponding efforts. Aiming to optimize the expected profits $P(m,Z) \in \mathbb{R}$ yields the following objective function:

$$P(m,Z) = R(m,Z) - C(m) = \tag{3.9}$$

$$\mathbf{1}_{(-\infty;o]}(V-Z)S_{com}\hat{w} + \mathbf{1}_{(0;\infty)}(V-Z)S_{com}w +$$

$$\frac{1}{g_2 d(1-mh)(B-A)}\Big\{\mathbf{1}_{(-\infty;o]}\big(g_2Z - g_2Bd(1-$$

$$mh)\big)\int_{g_2Z-g_2Bd(1-mh)}^{0}\hat{w}\, S_{ach}\, dS_{ach} + \mathbf{1}_{(0;\infty)}\big(g_2Z - g_2Bd(1-$$

$$mh)\big)\int_{g_2Z-g_2Bd(1-mh)}^{0}w\, S_{ach}\, dS_{ach} + \mathbf{1}_{(-\infty;o]}\big(g_2Z - g_2Ad(1-$$

$$mh)\big)\int_{0}^{g_2Z-g_2Ad(1-mh)}\hat{w}\, S_{ach}\, dS_{ach} + \mathbf{1}_{(0;\infty)}\big(g_2Z - g_2Ad(1-$$

$$mh)\big)\int_{0}^{g_2Z-g_2Ad(1-mh)}w\, S_{ach}\, dS_{ach}\Big\} - \{K_{fix} + m^2 k_{var} + K_{kom}\} =$$

$$max!$$

In formula (3.9) the objective function to determine the optimal communicated sustainability target and sustainability investment level is fully described. In section 4 we illustrate the practical application of the approach and discuss the utility of the model by using the example of a German beverage company and real-world data.

II.1.4 Practical Application using Real-World Data of a major German Beverage Company

We demonstrate the practical utility of our approach with data of a major German beverage company (GBC). At present, the GBC is preparing a report on the company's sustainability initiatives. The aim of this sustainability report is to communicate sustainability targets for certain sustainability indicators and to decide on the respective investment level to be spent on the related sustainability activities. The company thereby gives account on its economic, environmental, and social impact by covering several quantitative sustainability indicators. The GBC wants to show that they made a start on their way to incorporate more sustainable business practices. By making their progress on this way transparent, the GBC wants to avoid greenwashing criticism beforehand. Accordingly, the GBC deliberates which sustainability targets to communicate for single sustainability indicators. The GBC assumes that the credibility of sustainability activities is highly linked to the achievement of communicated sustainability targets. This incentive to set rather conservative targets is accompanied by a competitive market environment where several competitors have already published sustainability reports and have communicated sustainability targets. Consequently the GBC wants to communicate sustainability targets with respect to customer expectations on the one hand, but in line with value-based management, also considers the investments needed to achieve those communicated targets on the other hand, accounting for the ambiguous role of the economic sustainability dimension in business context. We solve this trade-off with our approach by simultaneously optimizing both, sustainability targets and the according sustainability investment levels for each sustainability indicator separately. With regard to the existence of a budget constraint, a company can afterwards rank the results of these different sustainability indicators and can choose the alternative(s) generating most benefits.

II.1.4.1 Optimization

The GBC applies our model to four sustainability indicators, namely waste water, number of complaints by the recycling company, breakage of glass, and water usage. In order to acquire the needed data to implement the model, experts from the company's sustainability management team were consulted and helped us to collect data for the input parameters. The minimum (maximum) output quantity A (B) for the sustainability indicators was derived by deviating the expected output quantity for the considered reporting period by -20% (+20%). This results in a minimum output quantity A=10,400,000 HL and a maximum output quantity B=15,600,000 HL. Since the GBC has several production sites with varying sustainability

performance, the technical feasibility h for each sustainability indicator is estimated by the best-practice value over all production sites. The efforts for sustainability activities were derived by former completed projects, with fixed efforts K_{fix}=10,000€ and communication efforts K_{com}=10,000€. As customer expectations are influenced by various factors, the customer expectation V is derived by the industry average of the major competitors of the GBC. The weight g_1=0.2 (g_2=0.8) for the communication level (achievement level) as well as the conversion factor w ($\hat{w}$) for positive customer satisfaction (negative customer satisfaction) are estimated by internal experts of the regarded company. These nonspecific input parameters i.e. input parameters which do not change for all sustainability indicators, are summarized in table II-1.1.

Table II-1.1 Nonspecific input parameters

Nonspecific input paramters	Input parameter value
Minimum output quantity A [HL]	10,400,000
Maximum output quantity B [HL]	15,600,000
Weight g₁ (communication level)	0.2
Weight g₂ (achievement level)	0.8
Fixed efforts K_fix [€]	10,000
Communication efforts K_com [€]	10,000

Since it is not possible to derive the analytical optima for Z_{opt} and m_{opt}, we use Matlab for the optimization and calculation of the results. Table II-1.2 shows the results for the four sustainability indicators and the respective optimal communicated sustainability targets and sustainability investment levels:

Table II-1.2 Results for sustainability indicators

Sustainability Indicators	Input parameters						Results			
	Specific consumption d (per HL)	Potential capacity h	Positive impact w	Negative impact ŵ	Customer expectations V	Variable efforts k_var	m_opt	Z_opt	L_max	L_min
Waste water (HL)	2.16	0.26	1.00	10	28,730,000	10,000,000	0.4943	28,730,000	29,365,457	19,576,972
Number of complaints by the recycling company (#)	0.000096	1.00	1.00	10	1,249	50,000	0.0274	1,376	1,458	972
Breakage of glass (t)	0.000126	0.96	1.00	10	1,634	150,000	0.0115	1,835	1,944	1,296
Water usage (HL)	3.81	0.21	1.00	10	45,456,667	10,000,000	0.9526	45,456,667	47,521,107	31,680,738

In case of the sustainability indicator waste water our recommendation to the GBC is an investment level of m_{opt}=0.4943 and a communicated sustainability target of Z_{opt}=28,730,000 HL, resulting in a maximized profit of $P(m_{opt},Z_{opt})$=795,192 €. The optimal investment level m_{opt}=0.4943 results in an investment of 4,963,000€ including fixed and communication costs. If no investment is undertaken (m=0) the potential indicator consumption is in the range of L_{min}=22,464,000 HL to L_{max}=33,696,000 HL. In this case the optimal communicated

sustainability target Z_{opt}=28,730,000 HL would be considered as rather ambitious to achieve[2]. If the optimal investment level of m_{opt}=0.4943 is implemented, the original specific indicator consumption d=2.16 is reduced to d=1.88, resulting in a possible indicator consumption of L_{min}=19,576,972 HL to L_{max}=29,265,457 HL after the investment. Thus the optimal communicated sustainability target Z_{opt}=28,730,000 HL can be assumed rather conservative. Taken together, our recommendation to communicate a sustainability target Z_{opt}=28,730,000 HL for the sustainability indicator is set with respect to customer expectations and is achievable with high probability if the according investment level of m_{opt}=0.4943 is carried out.

The application of our approach provides useful results to the GBC. First, customer expectations are considered within the optimization. Second we simultaneously optimize both, ambitious communicated sustainability targets and respective sustainability investment levels. Other potential solutions might only provide a sequential decision on the communicated sustainability target and sustainability investment level, which may lead to undesirable consequences. Setting sustainability targets based solely on experiences of management, for instance, would bear the risk that communicated sustainability targets are not achievable with the sustainability investment level at hand. Communicating a sustainability target of Z=28,500,000 HL for the sustainability indicator waste water, for instance, would require a sustainability investment level m=0.5140, reducing the resulting profit P(0.5140, 28,500,000 HL)=544,527 € by -31.52% compared to the solution of the simultaneous optimization. Setting the investment level according to a fixed rate of a company's overall investment budget and deriving communicated sustainability targets from this point would neglect customer expectations with potential customer dissatisfaction on the communication level. In the case of the sustainability indicator waste water, a fixed sustainability investment level m=0.4500 would yield a sustainability target of Z=28,730,000 HL but reduces the resulting profit P(0.4500, 28,730,000 HL)=705,543 € by -11.27% compared to the solution of the simultaneous optimization. Thus without a simultaneous optimization already minor misjudgments in the sequential decision on the communicated sustainability target and sustainability investment level result in a considerably worse profit P(m,Z).

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[2] For all four examples of sustainability indicators, $P(m=0,Z)<P(m>0,Z)$ holds true

II.1.4.2   *Sensitivity Analysis*

Model parameters like the weights of communicated and achieved target levels, the positive and negative impact on firm revenue due to customer (dis-)satisfaction, as well as the exogenously given customer expectations or variable efforts are needed to be estimated ex ante and mainly rely on the experience, opinions, and expectations of experts. Consequently, these parameters are subject to change and error. In order to evaluate, i.e. test the robustness and analyze the behavior of our model, we perform a sensitivity analysis (Pannell 1997; Triantaphyllou and Sánchez 1997). For our sensitivity analysis we change each input parameter by +/- 10% with respect to its original value estimated by the experts of the sustainability management team of the GBC. At the same time we keep all other input parameters constant. This procedure is executed with every input parameter of interest. The described sensitivity analysis is applied for one sustainability indicator, waste water, since the calculations for the remaining sustainability indicators are based on the same underlying function[3]. The results are shown in table II-1.3.

Table II-1.3 Sensitivity analysis

Case explanation	Input parameters						Results		Observation	
	Weight g_1	Weight g_2	Positive impact w	Negative impact ŵ	Customer expectations V	Variable efforts k_{var}	m_{opt}	Z_{opt}	Sensitivity m	Sensitivity Z
Base case	0.2	0.8	1.00	10	28,730,000	10,000,000	0.4943	28,730,000		
1. g_1 +10%	0.22	0.78	1.00	10	28,730,000	10,000,000	0.4910	28,730,000	-0.67%	0.00%
2. g_1 -10%	0.18	0.82	1.00	10	28,730,000	10,000,000	0.4976	28,730,000	0.67%	0.00%
3. g_2 +10%	0.12	0.88	1.00	10	28,730,000	10,000,000	0.4605	29,262,383	-6.84%	1.85%
4. g_2 -10%	0.28	0.72	1.00	10	28,730,000	10,000,000	0.4799	28,730,000	-2.91%	0.00%
5. w +10%	0.2	0.8	1.10	10	28,730,000	10,000,000	0.5017	28,730,000	1.50%	0.00%
6. w -10%	0.2	0.8	0.90	10	28,730,000	10,000,000	0.4871	28,730,000	-1.46%	0.00%
7. ŵ +10%	0.2	0.8	1.00	11	28,730,000	10,000,000	0.5000	28,730,000	1.15%	0.00%
8. ŵ -10%	0.2	0.8	1.00	9	28,730,000	10,000,000	0.4878	28,730,000	-1.31%	0.00%
9. v +10%	0.2	0.8	1.00	10	31,603,000	10,000,000	0.2920	31,603,000	-40.93%	10.00%
10. v -10%	0.2	0.8	1.00	10	25,857,000	10,000,000	0.7421	25,857,000	50.13%	-10.00%
11. K_{var} +10%	0.2	0.8	1.00	10	28,730,000	11,000,000	0.4813	28,730,000	-2.63%	0.00%
12. K_{var} -10%	0.2	0.8	1.00	10	28,730,000	9,000,000	0.5080	28,730,000	2.77%	0.00%

From the sensitivity analysis we can draw the following conclusions:

- The direction of changes is as one would expect from an analytical point of view: if variable efforts k_{var} increase (decrease), for example, the optimal investment level m_{opt} is decreasing (increasing).

- The optimal sustainability target Z_{opt} is always set conservative, i.e. rather towards the upper possible indicator consumption L_{max}. Additionally the optimal sustainability target Z_{opt} does never exceed customer expectations. Here the importance of the achievement level is higher than the importance of the communication level ($g_1 < g_2$).

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[3] We would be pleased to provide further results for other sustainability indicators on request.

Consequently the difference between communicated sustainability targets Z and achievements is more important than the difference between customer expectations V and communicated sustainability targets Z. That is why communicated sustainability targets Z do not exceed customer expectations V as this would otherwise reduce the difference between communicated sustainability targets Z and achievements.

- The results are quite robust: The change of communicated target Z_{opt} and investment level m_{opt} is small and in most cases lower than the 10% change of the input parameter values. One quite high variation of m_{opt} and Z_{opt} occurs for change of the weight g_2 by +10% to 0.88 in absolute terms. Due to the fact that $g_1+g_2=1$ needs to hold true, an increase of g_2 by +10% thus leads to a decrease of g_1 by -40% to 0.12 in absolute terms. This decrease of g_1 in turn leads to less ambitious targets, i.e. an increase of the optimal communicated sustainability target Z_{opt} of 1.85% which makes a lower investment level of m_{opt}=0.4605 necessary to achieve this communicated target. Another exception is a change of the customer expectations V by +/-10%. Here the optimal communicated sustainability target Z_{opt} changes in the same direction as the customer expectations V. In case of an increase (decrease) of the optimal communicated sustainability target Z_{opt} by +10% (-10%) a significantly lower investment level m_{opt} of -40.93% (50.13%) is necessary. Therefore special attention needs to be paid when estimating the customer expectation V.

The presented results and analysis provide the GBC with the necessary recommendations to set communicated sustainability targets and investment levels. The case study further shows the practicability and economic potential of our approach. The respective sensitivity analysis illustrates the robustness of the results. In the following section we critically discuss our approach, point out limitations and respective topics for future research.

II.1.5   Limitations, and Future Research

Our mathematical approach to simultaneously determine the optimal communicated sustainability target and investment level allows taking into account customer expectations, which is important as customer behavior determines business success. At the same time, it deals with the trade-off between corporate sustainability and business targets, i.e. it takes care of the ambiguous role of the economic dimension in business context, which emerges as additional organizational incentive to ensure business success in line with value-based management. Moreover, we simultaneously optimize both, ambitious communicated

sustainability targets and respective sustainability investment levels, whereas other potential solutions might only provide a sequential decision on the communicated sustainability target and sustainability investment level, which may lead to undesirable consequences. However, despite the contributions of this article, our results have to be seen in the light of some limitations.

First, whether communicated sustainability targets and achievements of a company influence the purchasing habit of all customers is debatable. Although a strong consideration of sustainability aspects is made by customers, this is not always reflected in their buying decisions. Furthermore, we only considered a homogenous customer group not further differentiating different customer segments. However, the consumer group "LOHAS", for instance, has other consuming standards than other consumer groups. Thus, to further specify the effects on firm value, heterogeneous customer segments should be used to better model real world conditions. Against this background also the classification of sustainability performance as one-dimensional attribute (cf., Kano et al. 1984) should be discussed. It might prove useful to classify sustainability performance different, i.e. as must-be attribute or attractive attribute for different customer segments. In our point of view, these draw backs can easily be solved in future research. However, as the current study constitutes a first attempt, a further level of detail is neither helpful nor necessary to focus on the problem in a first step. Second, besides the random output quantity other risk factors such as operational risks may influence a company's sustainability performance and should be considered in the approach. Third, potential rebound effects are neglected in our approach. Possibly high customer satisfaction due to ambitious sustainability targets and respective achievements might lead to additional demand and consequently an increase in sales. In consequence, the necessarily higher output quantity thus increases negative environmental impacts, for instance, resulting in a rebound effect. This problem can be addressed by additionally providing a reporting on a relative basis. Fourth, we only evaluated one sustainability indicator at a time. In doing so, we neglected any interdependencies (positive as well as negative) with respect to the communication and investment of several different sustainability indicators implemented simultaneously. Future research should thus focus on resulting synergies and rivalries of implementing different sustainability initiatives at the same time.

II.1.6   Conclusion

Customers expect companies to conduct business in a sustainable way. Companies see this expectation as one reason to engage in sustainable business practices, are attracted by the

potential chances of incorporating sustainability into their business practices and start making efforts beyond risk mitigation strategies. As communicated sustainability targets as well as respective achievements affect customer satisfaction which in turn leads to (rising) sales, a decision on both, communicated sustainability targets and investment levels, needs to be undertaken in an integrated way. Therefore, the aim of this paper was to provide support for economic well-founded decisions on communicated sustainability targets and respective investment levels. To achieve this, after a short theoretical background on sustainability reporting and customer satisfaction, we formalized the relation between communicated sustainability targets, sustainability investment levels, customer expectations, and customer satisfaction. Through mathematical optimization, we determined the optimal communicated sustainability target and investment level simultaneously. We applied the model using real world data of a German beverage company and showed how it helps to choose the optimal communication and investment levels while balancing chances and risks with respect to customer satisfaction. The results suggest that companies must set as ambitious sustainability targets as possible with respect to customer expectations and how customers value promised sustainability targets and achievements on the one hand. However, in line with value-based management, companies also have to keep in mind the needed investments (ambiguous role of economic perspective) to achieve those communicated targets on the other hand. The contribution of this paper is of relevance both, for research and practice. Although our approach makes several restricting assumptions and implies limitations which provide room for further research, as pointed out in section 5, it represents a first step to decide simultaneously on communicated sustainability targets and sustainability investment levels and furthermore introduces a systematic approach to align sustainability roadmaps to customer expectations.

II.1.7   Annotation 1

In order to derive analytical optima for Z_{opt} and m_{opt} we developed an approach where the customer satisfaction on the communication level S_{com} and on the achievement level S_{ach} are aggregated in an overall customer satisfaction S_{total}.

$$S_{total}(m, Z) = g_1(V - Z) + g_2(Z - L) = g_1(V - Z) + g_2[Z - Xd(1 - mh)] \tag{I}$$

$$S_{total}(m, Z) \sim u.d.\,[g_1(V - Z) + g_2Z - g_2Bd(1 - mh); g_1(V - Z) + g_2Z \tag{II}$$
$$- g_2Ad(1 - mh)]$$

$$f(S_{total}) = \frac{1}{g_2d(1 - mh)(B - A)} \tag{III}$$

If this approach is pursued analytical optima for Z_{opt} and m_{opt} can be derived. However, the results were not satisfactory with very high values for Z_{opt} and marginal investment levels m_{opt}. Those poor communicated sustainability targets led to huge disappointment on the communication level but were compensated by high customer satisfaction on the achievement level. Since both components were additive, overall customer satisfaction S_{total} was still positive without any investments and poor sustainability targets. In order to avoid this effect, we modified our approach and split up the overall customer satisfaction S_{total} for the communication level S_{com} and for the achievement level S_{ach}. Therefore negative customer satisfaction on the communication level S_{com}, due to poor sustainability targets, is directly punished by the impact factor $\hat{w}$.

II.1.8   References

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II.2   Research Paper 2: "Business Transformation towards Sustainability"

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Abstract:

Sustainability is becoming increasingly important in today's corporate world and can contribute to the current and future success of organizations. Integrating ecological, social, and economic objectives into corporate decisions is a key success factor for transformation towards sustainability. As sustainability is not achieved by single actions, but rather is an on-going process, decision-makers must have means to analyze the current state of an organization. For this, we first illustrate how companies can structure the field of action for the transformation towards sustainability. Furthermore, we propose a decision model to determine how sustainability actions should be implemented in accordance with the paradigm of value-based management, i.e., considering their economic effects. We illustrate the application of the approach using the example of a German medium-sized company.

Executive Summary:

Recently, organizations have recognized sustainability as an emerging mega-trend and as an increasingly important strategic goal. Its integration into the business model can be a key success factor, but also a challenge that requires a systematic approach. In order to comprehensively steer corporate sustainability, with the aim of minimizing negative externalities while maximizing positive effects, companies first need to structure their processes to achieve transparency on where sustainability actions can be incorporated. By furthermore considering the three dimensions of sustainability, possible starting points for

sustainability actions can be identified. These two perspectives are complemented by adapting the basic idea of stages of development and maturity to sustainability context, as a way to capture the progress of sustainability actions within each corporate activity. The resulting ''Sustainability Maturity Cube'' serves as a blueprint, i.e., a first generic approach, of how an organization can structure the field of action for the transformation towards sustainability. Considering the paradigm of value-based management in business context, economic effects of the trans-formation towards sustainability have to be regarded. We therefore, also propose a decision model, which allows aligning ecological, social and economic objectives in order to draw economically useful conclusions by determining the optimal increase of the sustainability maturity level. To evaluate whether our approach proves useful for subject matter experts who are involved in sustainability decisions, we provide a first example of how a specific company can transform towards sustainability.

II.2.1   Introduction

In recent years, sustainability issues have gained increasing attention and importance. A 2009 survey of 224 business leaders worldwide showed that 60 per cent of them believe that ecological and social responsibility has increased in importance over the past years (Hiddleberger and Hittner 2009). A MIT Sloan Management Study on sustainability further revealed that two thirds of the 4.700 respondents agree that sustainability is essential to competitiveness and nearly three quarters agree that sustainability is a permanent part of their agenda and that their commitment will further increase (Kiron et al. 2012). Many examples like the immense global CO_2 emissions, dwindling resources, child labor as well as the increasing gap between the richest and the poorest show that the consequences of our current way of living cause not only ecological but also social problems in the industrialized and developing countries (Lowe 1998).

Not only scarce resources and the emerging social problems, but also expectations of stakeholders of a company like its customers, investors, employees, suppliers, or society in general intensify the pressure on companies to integrate sustainable issues in their business. Companies need to manage these challenges to benefit from the transformational power of the development and thus make "sustainability" a key success factor (Hahn and Scheermesser 2006). Hence, its integration into the core business, i. e. business strategy, business model, and the value generating processes and products is required (Porter and Kramer 2006; Schaltegger and Müller 2008). Starting at strategy level, several types of sustainability strategies exist (Hardtke and Prehn 2001; Schaltegger et al. 2002; Baumgartner 2005). We distinguish introverted sustainability strategies (risk mitigation focusing on fulfilling legal and other external standards), extroverted sustainability strategies (legitimating approaches focusing on external relationships), conservative sustainability strategies (focusing on eco-efficiency), and visionary sustainability strategies (holistic approaches focusing on sustainability issues within all business activities) (Baumgartner and Ebner 2010). With regards to the business model and the underlying value generating processes and products, a wide range of management tools for implementing and measuring corporate sustainability has been developed (Schaltegger et al. 2002). As sustainability issues are being more and more institutionalized (Bansal and Bogner 2002; Bansal and Roth 2000; Prakash 2001) there are standardized management systems, guidelines, and official recommendations for environmental and social reporting, tools for the measurement of corporate sustainability, and applied concepts, which try to facilitate the integration of sustainability into organizations (please refer to Tab II-2.5 of the Appendix for an overview on exemplary selected tools and

management approaches). Tools for the measurement of corporate sustainability focus on controlling and managing the operationalization of sustainability strategies (Atkinson 2000; Figge and Hahn 2004a, 2004b; Huizing and Dekker 1992; Kaptein and Wempe 2001). The most prominent examples of sustainability measurement systems are the Sustainability Balanced Scorecard and sustainability maturity models: The first posits that for companies to contribute to sustainable development, it is desirable that corporate performance improves in all three dimensions of sustainability – economic, environmental, and social – simultaneously (Figge et al. 2002). Also the basic idea of (sustainability) maturity models, i. e. the concept of stages or levels of development, can be used to objectively evaluate a company's state with regards to sustainability and thus provides organizations a sensible tool to manage their sustainability capability (Becker et al. 2009; Kazanjian and Drazin 1989). The variety of tools and concepts shows the wide range of possibilities a company has for integrating sustainability into its business. It is therefore vital to structure the field of action by identifying where to start implementing sustainability (i. e. concrete possible starting points), what to do (exemplary sustainability actions), and where these actions have the greatest impact. Accordingly, our first research question is:

1. To transform towards sustainability, how can decision makers structure the field of action?

Although there are many studies concerning sustainable management, the overall economic effect of sustainability actions over all dimensions has not been investigated in detail yet. With the effects of ecological and particularly social actions being difficult to valuate, decision makers tend to neglect the economic consequences of sustainability actions as long as there is no structured approach for decision-making. It is thus the question how sustainability actions should be implemented in accordance with the paradigm of value-based management, i. e. considering economic effects. This leads to our second research question:

2. To transform towards sustainability, how should sustainability actions be implemented in accordance with value-based management, i. e. when considering their economic effects?

To answer the first research question, we show how one can structure an organization's processes exemplarily using Porter's value chain (1985) with the aim of achieving transparency on where sustainability actions can be incorporated. By furthermore considering the three dimensions of sustainability, we propose possible sustainability actions, i. e. we provide exemplary ideas on how to improve working conditions in production processes (social perspective) or optimization of delivery routes (ecological perspective) for instance. We complement these two perspectives (1st: Corporate Activities; 2nd: Dimensions of

Sustainability) by additionally introducing a way to capture the progress of sustainability actions, adapting the basic idea of stages of development and maturity to sustainability context. The resulting *Sustainability Maturity Cube* serves as a blueprint, i. e. a first generic approach, of how an organization can structure the field of action for the transformation towards sustainability. It can build the basis for the instantiation of concrete sustainability maturity models and for deriving corporate actions. We answer the second research question by adapting the decision model based on Kamprath and Röglinger (2011), who conveyed the principles of value-based management to decision-making with process maturity models. We oppose costs and benefits of sustainability actions in order to determine how sustainability actions should be implemented considering their economic effects.

With the *Sustainability Maturity Cube* as a blueprint and the decision model at hand, we contribute to theory and practice: First, we combine already existing and acknowledged scientific concepts, such as Porter's value chain and maturity models, and adapt them to a new problem context, i. e. business transformation towards sustainability. Second, our approach provides organizations with decision-support as it, besides structuring their field of action, aligns decisions regarding the transformation towards sustainability with the paradigm of value-based management, taking into account the ambiguous role of the economic dimension in business context.

The remainder of this paper is organized as follows: Section 2 provides theoretical background on sustainability, corporate sustainability, and the idea of maturity models. In section 3, we structure the field of action for the transformation towards sustainability. The resulting Sustainability Maturity Cube illustrates the coherence of sustainability maturity levels, i. e. the state of development or progress, the corporate activities and dimensions of sustainability respectively. Following these elaborations, the decision model of Kamprath and Röglinger (2011) is extended and adapted for the economic valuation of sustainability actions in section 4. Section 5 exemplarily demonstrates the applicability of the approach. In section 6 we briefly summarize the key findings and provide topics for future research.

II.2.2   Theoretical Background

II.2.2.1   *Sustainability – A Multidimensional Construct*

Sustainability and sustainable development (we use both terms synonymously in this paper) have been extensively discussed in academia and practice. As a broad range of aspects can be subsumed under the term sustainability, there is no common understanding and numerous definitions exist (cf. Kastenholz et al. 1996; Ruhwinkel 2013). Also Koplin (2006) concludes

that it is impossible to find a globally uniform definition that holds true for all actors and situations. Grounded already in the 17th century with a resource-focused, i. e. ecological understanding (overexploitation of forests), the term sustainability has broadened its focus over the last decades. Today's understanding of sustainability derives from the international conferences on environmental issues starting in the 1960's and 70's. Prominent examples are the report "The Limits to Growth" of the Club of Rome in 1972 and the Brundtland Report "Our Common Future", which was published by the World Commission on Environment and Development (WCED) in 1987. While the Club of Rome focused on the long-term consequences of consumption and production patterns like population growth and environmental pollution, the WCED gave the first substantial impulse for sustainable development by defining sustainability as a "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED 1987, Chapter 2, p.1). Sustainability actions can have social (e. g. concerning the equality of opportunities), environmental (e. g. concerning the quality of the eco-system), and economic (e. g. concerning a stable and healthy economy to ensure living conditions) implications. These three dimensions represent the three main pillars of sustainability and are also known as the "triple-bottom-line" concept (Elkington 1997). Whereas the success of the Brundtland definition stems from its opacity and its applicability in a growth context (Goodland 1995), also other definitions of sustainability (e. g. Ferguson et al. 2003; Epstein 2008) have the preservation and improvement of the economic, ecological, and social system for the benefit of existing and future generations in common.

The triple-bottom-line concept and the understanding of sustainability in the Brundtland Report furthermore share the belief that sustainable development requires implementing all dimensions, i. e. all pillars of sustainability equally and at the same time, as they are complementary, but not interchangeable. This concept can be described by the term strong sustainability (Figge et al. 2001). In contrast to that, weak sustainability is based on a theory within ecological economics saying that the different existing sorts of capital, i. e. human (social dimension), natural (ecological dimension), or manufactured capital (economic dimension) can be substitutes for each other (Cieges et al. 2009). Weak sustainability thus does not account for possible negative externalities (e. g. consequences of consumption of dwindling resources) caused by the substitution with capital.

The parallel implementation of all dimensions of sustainability can be complementary or rival. As targets in the social or ecological dimension are not necessarily targets from an economic perspective, there may result conflicts, especially in a short-term view. However, these

conflicts tend to resolve in the long-run. For example, keeping old technologies and realizing (short-term) economic savings, despite the existence of better solutions and hence causing higher environmental pollution, might result in customer dissatisfaction due to nonconformity with expected ecological behavior and thus decreasing sales that precipitate in the long-term. Ruhwinkel (2013) accordingly concludes that on a high level of aggregation, economic, ecological, and social developments are seen as an inner unity. Nevertheless, the difficulties regarding a clear definition, understanding, and thus operationalization of sustainability show that sustainable development is a complex and multidimensional issue, which has to combine efficiency, inter- and intra-generational equity on an economic, social, and environmental ground (Cieges et al. 2009; Ruhwinkel 2013). Thereby an "either or"-decision as well as the unyielding understanding of concepts like strong sustainability are not sufficient or too inflexible to describe the existing challenges and opportunities within this context. In this paper, we do not stick to one particular concept but follow the comprehensive but rather simplifying understanding of sustainability as a multidimensional concept that aims at ensuring or improving today's living standards including ecological, social, and economic aspects. Thereby, negative externalities need to be prevented or kept to a minimum while positive externalities need to be encouraged and supported. With the different dimensions of sustainability being mutually dependent, from our point of view the most important challenge is to decide which solution is the best trade-off between the rivaling or synergetic dimensions in each individual situation. Yet, in business context this is especially challenging as the economic dimension is of particular importance in conformity with the paradigm of value-based management.

II.2.2.2   *Corporate Sustainability*

In accordance with Freeman's stakeholder theory (Freeman 1984), researchers agree that companies have other responsibilities to their stakeholders besides economic issues (Salzmann et al. 2005). There are different concepts like corporate social responsibility (CSR), greening the business, eco-efficiency or eco-advantage (Schmidt et al. 2010) to address these responsibilities. Thereby, sustainability actions should be related to the context of the business, i. e. they should address issues of what is produced (products, services), how it is produced (processes), by whom (people), and its implication for stakeholders (Robinson et al. 2004).

However, what is the financial pay-off to seek justification for sustainability actions (Salzmann et al. 2005, p. 27)? The business case of sustainability has gained in importance –

and companies face a dilemma. In accordance with the paradigm of value-based management, the consideration of costs, benefits, and risks when deciding on an investment is necessary, plausible, and an accepted standard. The same needs to hold true for sustainability context. Investments in sustainability actions normally mean financial burdens at least in a short-term view, which do not, or if at all, might only pay-off e. g. due to the fulfilment of stakeholder needs in the long run (for example meet expectations of consumer groups like LOHAS [Lifestyle of Health and Sustainability (Ray and Anderson 2000)], green investment, CO2 emission certificates). Hence, securing survival in a market economy and at the same time integrating sustainability and "being good" or "being as sustainable as possible" does not necessarily resolve at first sight. It is impossible to give universally valid managerial advice on how to deal with conflicts between sustainability dimensions, the economic perspective however is of particular importance and can be seen as "ambiguous" in business context. Even though conflicts tend to dissipate in the long run according to Ruhwinkels' (2013) goal congruence of the three sustainability dimensions on a high aggregation level, an economic valuation is indispensable in accordance with value-based management as guiding principle. Thereby, the paradigm of value-based management implies that also long-term effects are considered in the valuation. Our understanding of corporate sustainability hence implies that the economic dimension needs to be treated with a special focus: on the one hand it is one of the three pillars of sustainability, but at the same time, as companies need to follow economic principles to survive in competition and to achieve long-term business success, it emerges as an additional organizational incentive when engaging in sustainability transformations (Seidel et al. 2010). This differentiates the economic dimension from the other two dimensions of sustainability.

II.2.2.3   Stages of Development and Maturity

Based on the assumption of predictable patterns of organizational evolution and change, maturity models typically represent theories about how an organization's capabilities evolve in a stage-by-stage manner along an anticipated, desired, or logical path from an initial state to maturity (van den Ven and Poole 1995; Kazanjian and Drazin 1989). Accordingly, they are also termed stages-of-growth models, stage models, or stage theories (Prananto et al. 2003). In a wider definition, a maturity model is a management artifact that supports the systematic improvement of a complex, multi-faceted process or function - such as sustainability management. In a much narrower definition, maturity models are regarded as synonyms for assessment artifacts like e.g. the Capability Maturity Model Integration (CMMI) proposed by the Software Engineering Institute at Carnegie Mellon University (Paulk et a. 1993). Maturity

models apply different stages of development or maturity as a measure to evaluate the capabilities of an organization in regards to a certain discipline, and thus provide a framework for prioritizing improvement actions that are meaningful to the organization (de Bruin et al. 2005; Iversen et al. 1999). The objective is hence to assess the as-is situation, to incrementally build skills and capabilities, and to outline the stages of maturation paths in order to diagnose and eliminate deficient capabilities (Rummler and Brache 1990). Thereby, the maturity levels indicate an organization's current (or desirable) capabilities with regard to a specific class of entities (objects, application domains) (Rosemann and de Bruin 2005) meaning that if those capabilities are fulfilled, a certain level of maturity is achieved. By starting to look at single activities, companies can appraise their capability stage by appraising their existing process, so their performance indicators such as productivity, profitability, or customer satisfaction can be improved. For the remainder of this paper, the wider understanding of maturity models is of particular relevance to us as, with the *Sustainability Maturity Cube*, we intend to provide a blueprint that supports business transformation towards sustainability on a conceptualization level by structuring the field of action.

There now exist more than 150 different maturity models in various domains of application (de Bruin et al.2005) and also some that can be applied to describe the transformation towards sustainability (please refer to Tab. II-2.6 in the Appendix for an exemplary range of sustainability maturity models found in literature). The focus of sustainability maturity models is on providing a scheme that supports the development, establishment, and persecution of a sustainability strategy for a company (Baumgartner and Ebner 2010). In literature, the terms sustainability maturity model and sustainability capability maturity model are used synonymously. We use the notion sustainability maturity model throughout the remainder of this paper. Sustainability maturity models basically apply a slight modification of the maturity levels of the CMM or CMMI respectively to define a five-level maturity grid: At Level 1 sustainability maturity is initial, there's little understanding of the subject and few or no related policies. Level 2 stands for a rudimentary level. Companies begin considering sustainability aspects in corporate decision-making, which means that – if existing – only mandatory rules and laws are respected. Maturity level 3 marks an elementary integration of these aspects into corporate strategy. In compliance with sustainability-related laws the organization has developed capabilities and skills and encourages individuals to contribute to sustainability programs. Level 4 represents a satisfying consideration and maturity of the specific sustainability aspect (often above the industry average). Sustainability is a core component of the business planning life cycles. Sophisticated maturity is defined by level 5, which

implicates an outstanding effort towards sustainability. The organization employs sustainability practices across the entire enterprise and includes customers, suppliers, and partners. The industry recognizes the organization as a sustainability leader and uses its sustainability maturity practices to drive industry standards. (Baumgartner and Ebner 2010)

II.2.3   Structuring the Field of Action

To structure the field of action for the transformation towards sustainability, we need a conceptual framework to cover a holistic view of an organization's business model. By this means, we can capture and systematize those Corporate Activities (1st perspective) which might be critical for the value creation i. e. the success of a company. For all identified corporate activities we furthermore add the perspective Sustainability (2nd perspective) to enable analyzing the current state of sustainability, compartmentalized in its three dimensions (social, ecological, and economic). As a result, we are able to illustrate exemplary starting points for sustainability actions (Tab. II-1) for the transformation towards sustainability in each corporate activity and for each dimension of sustainability. By adding Sustainability Maturity Levels as a third perspective to the resulting Sustainability Maturity Cube (Fig. II-1), we offer a blueprint that allows for describing different stages of development or progress for all sustainability actions.

II.2.3.1   *Identification and Systematization of Starting Points for the Transformation towards Sustainability*

To identify adequate starting points for integrating sustainability, one needs to analyze the business system as a whole. By systemizing corporate activities (and underlying processes respectively) and the three dimensions of sustainability, we enable the application of sustainability maturity models to valuate transformation options on the most granular stage of a business system. Therefore, we systematically identify and illustrate those factors that may represent critical success factors for value creation and hence starting points for transformations towards sustainability.

There are various frameworks that support identifying core corporate activities: Rosemann and de Bruin (2005) for example name "strategic alignment", "culture", "people", "governance", "methods", and "IT" as critical success factors that influence process success and hence business success respectively. Osterwalder and Pigneur (2002) present nine building blocks to describe or build a company's business model, i. e. how an organization creates, delivers, and captures value (Osterwalder and Pigneur 2002): key partners, key resources, key activities, key relationships, customer segment, channels, revenue streams,

value propositions, and cost structure. Analogously, Porter's value chain (1985) helps to identify and structure those activities, which lead to a company's competitive advantage. It enables the separation of the business system into a series of single strategic relevant activities that are value generating by distinguishing primary value chain activities and support activities. The primary activities are divided into the categories inbound logistics, operations, outbound logistics, marketing & sales, and service. These activities are directly related to the physical creation of a product, its sale and transfer to the customer as well as to the aftersales assistance. Thereby, all these activities are directly affecting customers' perception and thus, the accumulation of value for the certain product or service, or for the company in total. As this methodology is highly known and recognized by researchers and practitioners (Sanchez and Heene 2003), it builds the basis of our blueprint. However, Porter's value chain is just an exemplary framework to structure the field of action, and can be replaced by any other framework. Especially when focusing e. g. on the service sector, other frameworks which are not designed primarily for production issues could be used in order to account for inherent industry specifics. Independently of the respective industry though, the general framework of Porter's value chain has to be adapted to each company individually (Porter 1985). Table 1 lists the primary and support activities (thereafter referred to as corporate activities) following Porter (1985) in the lines. This first perspective indicates where in the value chain companies can start the transformation towards sustainability. Adding the three dimensions of sustainability as second perspective further allows specifying these starting points. Thereby, several frameworks can provide support like the Global Reporting Initiative's G4 Sustainability Reporting Guidelines (GRI-guidelines) or Silvius and Schipper (2010) who suggested a checklist for successfully integrating sustainability in projects and project management. Although several other reporting guidelines have emerged like the OECD Guidelines for Multinational Enterprises (OECD 2011), or the UN Global Compact "Ten Principles" (United Nations Global Compact 1999), the GRI-guidelines are the most comprehensive and recognized standard (Brown et al. 2009; Global Reporting Initiative 2013). They provide an intuitive and clear overview to introduce and classify exemplary starting points for the transformation towards sustainability. In our paper, we thus follow these guidelines.

Tab. II-2.1 Illustration of exemplary starting points (fields), classified according to the GRI-guidelines, for the transformation towards sustainability, structured by corporate activities following Porter (1985) (1st perspective, lines) and the three dimensions of sustainability (2nd perspective, columns)

Primary Activities (Manufacturing Industry)					
	Activity	**Description of Activity**	**Exemplary Starting Points for Transformation towards Sustainability**		
			Social Dimension	**Ecological dimension**	**Economic Dimension**
Primary Activities	Inbound Logistics	Inbound Logistics include the procurement of raw materials, their warehousing, inventory control, vehicle scheduling, and returns to suppliers.	• **Labor Practices and Decent Work, Human Rights:** Fair working conditions (e.g. part-time model)	• **Transport:** Improve vehicle scheduling to reduce CO_2-emissions (e.g. algorithmic optimization of routes)	• **Economic Performance:** Improve warehousing time (e.g. Kanban System)
	Operations	Operations include all activities that are associated with the transformation of inputs into the final product form. Exemplary activities are machining, packaging, assembly, equipment maintenance, and testing.	• **Labor Practices and Decent Work, Human Rights:** Fair working conditions (e.g. no child labor in textile industry)	• **Energy:** Usage of modern machines with a good energy balance and efficiency • **Materials:** Recyclable packaging materials	• **Economic Performance:** Usage of modern machines with a good energy balance and efficiency
	Outbound Logistics	Outbound Logistics include activities that are associated with collecting, storing, and physically distributing the end product to customers. Examples are warehousing, material handling, delivery vehicle operation, order processing, and scheduling.	• **Labor Practices and Decent Work, Human Rights:** Fair working conditions (e.g. working hours)	• **Transport:** Improve vehicle scheduling to reduce CO_2-emissions (e.g. managed order cycles (economies of scale), degree of capacity utilization in shipping)	• **Economic Performance:** Improve warehousing time (e.g. just-in-time production)
	Marketing and Sales	Marketing and Sales include all activities that are associated with providing a reason by which customers want to purchase the product and tempt them to do so. Exemplary activities are advertising, promotion, sales force, quoting, channel selection, channel relations, and pricing.	• **Human Rights:** Promotion or image campaigns can propagate the companies' sustainable products, services or manufacturing processes	• **Materials, Effluents and Waste:** By using less print and focusing more on online marketing, firms can reduce material input	• **Economic Performance:** By using less print and focusing more on online marketing, firms can reduce material input
	Service	Service includes all activities that are	• **Materials:** Long life guarantees	• **Materials Effluents and**	• **Economic Performance:**

		associated with providing the service to enhance or maintain a products' value, such as installation, repair, training, parts supply, and product adjustment.	• **Society:** Free service guarantees in case of damage within a certain period of time after the buy	**Waste:** Ensure long lifetime of products	Free service guarantees

Support Activities (Manufacturing Industry)					
Support Activities	Procurement	The procurement deals with purchasing inputs, such as materials, supplies and equipment.	• **Human Rights:** Fair trade	• **Materials:** Choice of resources (e.g. recyclable materials, avoiding or reducing the usage of scarce resources)	• **Economic Performance:** Choice of material
	Infrastructure	The infrastructure of a firm includes for example the general management, planning, finance, accounting, legal, government affairs, quality management, organizational structure, control systems as well as the company culture.	• **Labor Practices and Decent Work:** Volunteering projects like mentoring programs as a part of a companies' daily life	• **Energy:** Proper communication systems improve virtual meetings and reduces necessity to travel • **Energy:** Intelligent Housing reduces energy consumption	• **Economic Performance:** Proper information systems can lead to competitive advantages, Intelligent Housing
	Human Resources	The Human Resource Management includes all activities associated to recruiting, hiring, training, development, and compensation of all types of personnel.	• **Labor Practices and Decent Work:** A responsible treatment of employees, e.g. healthy work environment • **Labor Practices and Decent Work:** company kindergarten • **Labor Practices and Decent Work:** employee training	• **Materials, Effluents and Waste:** By using less print and focusing more on online recruiting, firms can reduce material input	• **Economic Performance:** Sustainable process in hiring, can reduce costs due to effective choices of the right and fitting personnel
	Technology Development	The technology development, which includes for example activities like component design, feature design, field-testing, process engineering, and technology selection, sums up technologies that support the value-creating activities.	• **Labor Practices and Decent Work:** Fair working conditions (e.g. home office to combine work and family life)	• **Energy:** Implementing measures of Green IS • **Energy:** improve communication (reduce travel times)	• **Economic Performance:** Use IT as enabler (e.g. improve communication and reduce travel times, intelligent housing)

After having proposed a way to identify and systemize possible corporate activities and related starting points for transformation towards sustainability, in the next step the underlying processes and hence their specific possible transformation need to be analyzed. By doing so,

one can define current stages of development and achieve transparency regarding definite and necessary actions which have to be implemented in order to reach a targeted stage. For this, we propose sustainability maturity models that enable describing current and targeted sustainability maturity levels.

II.2.3.2   The Sustainability Maturity Cube

Depending on the progress and strength of the transformation towards sustainability in the respective company, different stages of development within each sustainability dimension and corporate activity and hence within each starting point can be reached. A company that has already implemented sustainable actions at some stages could have achieved a certain level of maturity in some of the identified corporate activities and thus can improve its actual situation by further transformation.
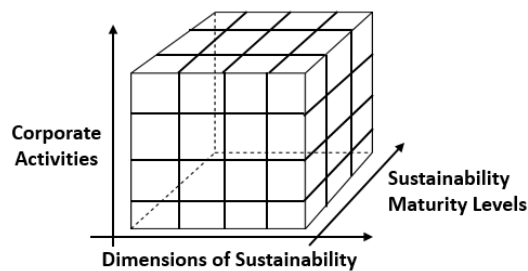

Fig. II-2.1 "Sustainability Maturity Cube"

Fig. II-2.1 summarizes the resulting *Sustainability Maturity Cube*. The perspectives, namely the *Corporate Activities*, the *Dimensions of Sustainability*, and the according *Sustainability Maturity Levels* form a cube that structures the possible field of action regarding transformations towards sustainability. One field of the cube represents the description of a certain sustainability maturity level in one of the three dimensions of sustainability for one identified corporate activity. Thereby, the *Sustainability Maturity Cube* can be seen as a blueprint that is based on acknowledged scientific concepts to support the systematic improvement of sustainability management by considering certain corporate activities, the three dimensions of sustainability and the corresponding stages of development. Of the three perspectives of the cube, only the operationalization of the *Dimensions of Sustainability* is fixed: Our understanding of sustainability as a multidimensional concept that aims at ensuring or improving today's living standards including ecological, social, and economic aspects leads to the three dimensions, i. e. ecological, social, and economic dimension. Regarding the other two perspectives, we only suggest applicable frameworks like Porter's value chain and maturity models, which are not further predefined, to describe the perspectives *Corporate*

Activities and *Sustainability Maturity Levels* respectively. Hence, the *Sustainability Maturity Cube* provides the basic understanding and concept for transformations towards sustainability. It furthermore allows for developing concrete sustainability maturity models. At this point, we do not instantiate a concrete sustainability maturity model ourselves in order to keep the generic character of our approach. However, there are several issues that have to be considered when instantiating a concrete sustainability maturity model, such as the determination of current and targeted sustainability maturity levels, the formulation of concrete development paths from initial to desired maturity levels, the consideration of confounding effects (e. g. when implementing several actions at the same time), and situations when it makes sense to invest in a particular action or not. We address some of these issues in the real-world application of the *Sustainability Maturity Cube* in the section in Sect. 5 and thus provide first insights in such an instantiation. We will now focus on our second research question: the overall economic valuation of the transformation towards sustainability.

II.2.4 Decision Model

In accordance with value-based management, it is a main target of a company to identify the priority sustainability actions to improve on. To do so, based on the ideas of Kamprath and Röglinger (2011), the implementation of sustainability actions in order to increase sustainability maturity levels are regarded as investments. Kamprath and Röglinger (2011) analyze the general economic relationship of process improvement with maturity models and develop an economic decision model. The basic idea of the model is to consider the improvement of the maturity level as investment(s) with resulting cash in- and outflows. It is aim of the model to identify the configuration of improvement actions that maximize the total additional present value cash surplus. Consequently, the cash flows that come along with improvements of sustainability maturity levels have to be examined

II.2.4.1 Assumptions of the Decision Model

In doing so, some prerequisites have to hold true: Most maturity models are based on the assumption that maturity levels only take integer levels (Software Engineering Institute 2010) but in practice there might be maturity levels in between integer values. Hence, the underlying model uses real-valued maturity levels. Furthermore, determining the concrete monetary values of the consequences of sustainability actions may require applying approaches such as Power (2008) who for example measures the emerging benefits of investments that increase energy efficiency solely on the basis of utility values for environmental, social or economic benefits. Furthermore, we assume that some metrics can be estimated ex ante. However, being

aware that this does not hold true for all metrics we elaborate on which metrics can be estimated and which cannot: There are numerous frameworks of sustainability assessment, which can provide assistance in determining such sustainability metrics. Most of the frameworks presented in Tab II-2.5 of the Appendix , e. g. the Global Reporting Initiative, the environmental management systems, such as the ISO and EMAS standards, or the study of the Center for Waste Reduction Technologies (CWRT) of AIChE (2004) provide a variety of possible sustainability indicators. While it is important to assess sustainability with several indicators, it may sometimes be difficult to make business decisions and comparisons among companies as these indicators are measured in very different units (Krajnc and Glavic 2005). Hence, sustainability indicators are helpful for decision-making but need to be examined carefully for their use in decision models.

With regard to the different dimensions of sustainability, we find that all environmental problems can finally be traced back to physical and/or chemical interventions (Heijungs and Guinée 1992). Contrary, due to the great variety and diversity of social aspects and the lack of a common foundation in natural sciences as found for environmental aspects, it is very difficult to achieve a comprehensive classification of social aspects (Clarkson 1995). Even more, social aspects heavily depend on the preferences and values of the different actors involved (Zadek 1999). The stakeholder approach (Freeman 1984) for example provides a useful framework to classify the actors concerned with different social claims as it clarifies the interested groups and their wants and desires (Clarkson 1995). (Figge et al. 2002)

II.2.4.2   *Formulation of the Decision Model*

Depending on whether a company already applies sustainability maturity models or not it may already has achieved a certain sustainability maturity level in the identified starting point for transformation towards sustainability P_{ij} where there are C_i $(0 \leq i \leq n)$ identified corporate activities and D_j $(1 \leq j \leq 3)$ dimensions of sustainability. Thus, each of the $i \cdot j$ starting points has a current sustainability maturity level which is $m_{ij}^{cur} \in \mathbb{R}_0^+$ $\left(m_{ij}^{min} \leq m_{ji}^{cur} \leq m_{ji}^{max}\right)$, whereby $m_{ij}^{max} \in \mathbb{R}^+$ represents the highest achievable sustainability maturity level and $m_{ij}^{min} \in \mathbb{R}_0^+$ $(m_{ij}^{min} < m_{ij}^{max})$ is the lowest realisable sustainability maturity level. The sustainability maturity level of each starting point can be increased by Δm_{ij} $(0 \leq \Delta m_{ij} \leq m_{ij}^{max} - m_{ij}^{cur})$. An aggregation function $g(\overrightarrow{\Delta m_i})$ with $\overrightarrow{\Delta m_i} = (\Delta m_{i1}, \Delta m_{i2}, \Delta m_{i3})^T$ considers potential synergies or rivalries between the different dimensions of sustainability (e. g. higher costs for fair trade products in procurement) within one corporate activity.

Additionally, there is a second aggregation function $f(\overrightarrow{\Delta m})$ with $\overrightarrow{\Delta m} = (\overrightarrow{\Delta m_1}, \dots, \overrightarrow{\Delta m_n})^T$ which aggregates the total sustainability maturity level regarding the synergies and rivalries between different corporate activities. Both functions will not be examined in detail in this paper (Kamprath and Röglinger 2011).

Implementing actions to improve sustainability (and thus the sustainability maturity level) requires investments I. These payments may differ from starting point to starting point and may not be necessarily completed in one period; therefore the net present value of the investment I will be applied. Whereas small improvements of the sustainability maturity level can be implemented relatively straightforward, greater improvements of the sustainability maturity level are expected to require a more complex approach, which results in higher cash outflows. This relationship holds true e. g. in project management or software engineering (Boehm et al. 2000) and also in the context of sustainable development as complexity will grow with more sophisticated actions. Additionally, it has to be taken into account that depending on the current sustainability maturity level for each starting point (m_{ij}^{cur}) the investment payment I differs, i. e. it grows positively related with the current value of m_{ij}^{cur}. Thus, a strictly monotonic increasing, strictly convex, and twice continuously differentiable function $I_{ij}^{cur}(\Delta m_{ij}) \in \mathbb{R}_0^+$ (e. g. a quadratic function) can characterize the investment I which is necessary for increasing the sustainability maturity level of each starting point P_{ij} by a certain Δm_{ij}. The following equation can be applied:

$$I_{ij}^{cur}(\Delta m_{ij}) = I_{ij}(m_{ij}^{cur} - m_{ij}^{min} + \Delta m_{ij}) - I_{ij}(m_{ij}^{cur} - m_{ij}^{min}) \tag{1}$$

Additionally to the investments I, the cash in- and outflows of the respective operational business have to be considered. There will be cash outflows O to ensure the continuous implementation and the support for sustainability. The more sustainability actions are implemented the more complex the integration with existing actions (investments I) and the more difficult to maintain a high sustainability maturity level over a long period of time. Therefore, a strictly monotonic increasing, strictly convex, and twice continuously differentiable function $O_{ij}^{cur}(\Delta m_{ij}) \in \mathbb{R}_0^+$ (e. g. a quadratic function) can be applied to characterize the cash outflows O that come along with increasing the sustainability maturity level of each starting point P_{ij} by Δm_{ij}.

Besides, there are other direct economic consequences resulting from the investment in sustainability for each starting point P_{ij}: Savings S. One example for these savings regarding the corporate activity "Human Resources" can be: By improving working conditions and thus

employees' satisfaction, the fluctuation of employees (turnover rate) and thus the need to spend more on recruiting can be reduced (Arnold and Feldman 1982). A strictly monotonic increasing, strictly concave, and twice continuously differentiable function $S_{ij}^{cur}(\Delta m_{ij}) \in \mathbb{R}_0^+$ (e. g. a root function) can characterize these direct savings S.

On the other side, the most important factor influencing the price and quantity of sales, i. e. cash inflows E is the customers' willingness to pay. The customers and especially the aforementioned LOHAS (Lifestyle of Health and Sustainability) (Ray and Anderson, 2000), are expected to be willing to pay more for a more sustainable product or service. These shifts in human attitude are difficult to trace but recent studies show that customers' mind-sets changed towards a more sustainability oriented direction: A survey conducted by market research group GfK suggests that consumers in five of the world's leading economies are turning to "ethical consumerism" (Grande 2007). Furthermore, consumers claim they would pay a 5-10% premium for ethical products even though a practical analysis shows that such brands have relatively small market shares (Grande 2007). Hence, if a company succeeds in satisfying the expectations of these customers, it positively affects their customer satisfaction (Matzler, 2000), customer loyalty and reference potential, i. e. the number of potential customers that one customer can reach during his lifetime (Rudolf-Sipötz 2001). The named effects finally result in higher expected customer cash flows (Krafft 1999) and in an alteration of the customer lifetime value (CLV), which is the present value of all future profits generated from a customer (Gupta and Lehmann 2003). The CLV can thus be applied to estimate customers' reactions to sustainability actions. Furthermore, as the CLV is difficult to determine, the perception of the customers can also be evaluated by questioning the customers in structured surveys. As customers and especially LOHAS are assumed to be price sensitive we can assume a strictly monotonic increasing but - due to the diminishing marginal utility - strictly concave and twice continuously differentiable function $E^{cur}\left(f(\overrightarrow{\Delta m})\right) \in \mathbb{R}_0^+$ (e. g. a root function) to characterize the cash inflows E that come along with increasing the sustainability maturity level of each starting point P_{ij} by Δm_{ij}. Summarizing, the following equations can be applied to determine the value of the resulting cash in- and outflows for each starting point P_{ij}:

$$O_{ij}^{cur}(\Delta m_{ij}) = O_{ij}(m_{ij}^{cur} - m_{ij}^{min} + \Delta m_{ij}) - O_{ij}(m_{ij}^{cur} - m_{ij}^{min}) \tag{2}$$

$$S_{ij}^{cur}(\Delta m_{ij}) = S_{ij}(m_{ij}^{cur} - m_{ij}^{min} + \Delta m_{ij}) - S_{ij}(m_{ij}^{cur} - m_{ij}^{min}) \tag{3}$$

$$E^{cur}\left(f(\overrightarrow{\Delta m})\right) = E(m^{cur} - m^{min} + f(\overrightarrow{\Delta m})) - E(m^{cur} - m^{min}) \tag{4}$$

Finally, it is the question, which target determines the optimal improvements of the sustainability maturity level. In accordance with the principles of value-based management the regarded company strives for the maximization of the total additional payments surplus $CF(\overrightarrow{\Delta m}) \in \mathbb{R}$. This results from the difference between the investment I and the payments surplus of the cash outflows O and cash inflows S and E:

$$MAX: CF(\overrightarrow{\Delta m}) = -\sum_{i=1}^{n}\sum_{j=1}^{3} I_{ij}^{cur}(\Delta m_{ij}) - \sum_{i=1}^{n}\sum_{j=1}^{3} O_{ij}^{cur}(\Delta m_{ij}) +$$

$$\sum_{i=1}^{n}\sum_{j=1}^{3} S_{ij}^{cur}(\Delta m_{ij}) + E^{cur}(f(\overrightarrow{\Delta m})) \tag{5}$$

The initial optimal strategy is the one, which maximizes the expected value of the objective function given the initial beliefs. We solve this optimization problem by obtaining the derivatives of the function of the total additional payments surplus. The first partial derivatives in the universal form are:

$$\frac{\partial CF(\overrightarrow{\Delta m})}{\partial \Delta m_i} = \frac{\partial I_{ij}^{cur}(\Delta m_{ij})}{\partial \Delta m_i} - \frac{\partial O_{ij}^{cur}(\Delta m_{ij})}{\partial \Delta m_i} + \frac{\partial S_{ij}^{cur}(\Delta m_{ij})}{\partial \Delta m_i} + \frac{\partial E^{cur}(f(\overrightarrow{\Delta m}))}{\partial \Delta m_i} \tag{6}$$

$$\frac{\partial CF(\overrightarrow{\Delta m})}{\partial \Delta m_j} = \frac{\partial I_{ij}^{cur}(\Delta m_{ij})}{\partial \Delta m_j} - \frac{\partial O_{ij}^{cur}(\Delta m_{ij})}{\partial \Delta m_j} + \frac{\partial S_{ij}^{cur}(\Delta m_{ij})}{\partial \Delta m_j} + \frac{\partial E^{cur}(f(\overrightarrow{\Delta m}))}{\partial \Delta m_j} \tag{7}$$

Based on the first partial derivatives the partial marginal solutions, conditions, and characteristics of an internal solution can be obtained. For a detailed description on how to determine these values we refer the interested reader to Kamprath and Röglinger (2011).

As the target of this paper is to introduce a blueprint for the transformation of companies towards sustainability, the applied functions are not further specified. Each company, which aims at aligning ecological, social, and economic objectives and drawing economically useful conclusions in this context, has to customize the proposed functions. Furthermore, potentially existing synergies and rivalries between the dimensions of sustainability and between the corporate activities have to be further examined as they were not analyzed in detail in this model. Additionally, the individual actions to reach the economically optimal target have to be outlined. Altogether, the presented decision model allows identifying the economically optimal increase of the sustainability maturity level of each identified corporate activity and thus represents a first approach to quantify decisions regarding transformation towards sustainability.

II.2.5   Operationalization of the Approach

As the real-world application of a model generally allows drawing interesting implications for its further operationalization, in the following we describe an example of how to manage sustainability projects in practice, applying our approach. We were able to accompany the instantiation of the *Sustainability Maturity Cube* and the application of our decision model in an in its branch leading and listed German middle-sized company. To outline how a specific company can transform towards sustainability, we first present the data collection process and then define the corporate activities and their current sustainability maturity levels. To test the robustness of our approach we perform a sensitivity analysis based on these findings.

II.2.5.1   Data Collection

There are various possibilities of how to acquire genuine values for the theoretically developed input parameters. Publicly available data e. g. by the Federal Statistical Office, other public or scientific institutions or historic and current intra-corporate data (e. g. in a data warehouse) are viable sources. Also conducting studies or consultations of external experts (e. g. interview of stakeholders) allows defining the input parameters. Furthermore, for the specific sustainability context almost all of the frameworks introduced in Tab. II-2.5 of the Appendix (e. g. the Global Reporting Initiative, the environmental management systems) provide sustainability indicators that can offer guideline on how to determine the necessary input parameters of our decision model.

The regarded company has already been awarded for its customer focus and innovative business model and states, e. g. in its annual reports and on the company homepage that sustainability plays an important role for its success. Experts from different business areas of the company (amongst other IT, market management, and executive management) helped us to reflect on the approach and to collect data for the input parameters. Although the subject-matter experts were willing to participate in the evaluation of the current status and the practices we were not able to cope with the complexity of the entire existing sustainability issues. We faced the following major challenges: Transforming the experiences with sustainability projects into functions is not straightforward and complex interrelations may need to be simplified. The same holds true for the synergies and rivalries between corporate activities and the dimensions of sustainability. Nevertheless, we gained valuable insights into the difficulties encountered during data collection and analysis regarding whether the decision model creates utility. To sum it up, with consulting internal experts of the regarded company we determined parts of the input parameters. Those input parameters however that could not

directly be assessed in the interviews were estimated based on other publicly available data and the aforementioned scientific sustainability frameworks.

II.2.5.2 Identification of Sustainability Actions and corresponding Starting Points

In a first step, the so far only abstractly defined perspectives of the *Sustainability Maturity Cube* (Corporate Activities, Sustainability Maturity Levels) have to be substantiated. The company chooses Porter's value chain to structure the corporate activities (1st perspective), and the sustainability maturity model of Cagnin et al. (2005) whose sustainability maturity levels develop from ad hoc (1), Planned in Isolation (2), Managed with No Integration (3), Excellence at Corporate Level (4), to High Performance Sustainability Net (5) (2nd perspective). Hence, we have: $m_{ij}^{min} = 1$ and $m_{ji}^{max} = 5$.

For the instantiation of the *Sustainability Maturity Cube*, several more issues need to be considered: To analyze the current sustainability maturity level in the regarded company we had a look at corporate strategy and its operationalization: As maximum customer benefit is a main corporate goal, its products are designed to help its customers to operate in a sustainable manner. The interviews conducted allowed us to break this strategic goal down to the different dimensions of sustainability. The company is involved in the following sustainability actions and we were hence able to identify the following corresponding starting points:

- Regarding the ecological commitment, constant improvement of the products with a view to reducing the consumption of power, water and all resources that are involved in the use and production of the products is most important (starting point is corporate activity "operations" and ecological dimension).

- Social commitment is achieved by acting responsibly towards employees which means an appropriate work-life balance and direct participation of employees in the success of the company (starting point is corporate activity "outbound logistics" and social dimension).

- Further social commitment is achieved by actively supporting social and cultural activities in the region (starting point is corporate activity "infrastructure" and social dimension).

- Considering the economic dimension, the following findings were deduced from the interviews: For the regarded company sustainable and long-term economic activity is more important than achieving short-termed profits. This is reflected in a high customer

satisfaction, which ultimately results in the continuous growth of sales and profits, and in a high employee satisfaction.

As the interviews revealed that the company did not yet focus on specifying the definite starting points regarding the dimensions of sustainability, the subject matter experts were asked for their indications of the sustainability maturity levels of the corporate activities. For each corporate activity, the questions considered not only the assessment of the current state of sustainability within the company (number of measures applied, evaluation of level of management involvement) but also its expected potential (number of measures approved or planned). The survey was conducted on a five-step Likert scale (1 = low; 5 = high), which allows to translate the answers into sustainability maturity levels. Considering the varying answers of the experts from different business areas, the aggregated current sustainability maturity levels of the corporate activities (weighted average over all answers from the experts) were defined as follows:

C_1: Operations ($m_1^{cur} = 1.00$)

C_2: Outbound Logistics ($m_2^{cur} = 1.00$)

C_3: Infrastructure ($m_3^{cur} = 1.67$)

II.2.5.3 Determination of the economically optimal Increase of the Sustainability Maturity Levels

To derive the economic consequences, the investments, cash outflows, savings, and cash inflows have to be estimated according to the business cases the company had developed for single sustainability decisions. We assume that each component of the total additional payments surplus $CF(\overrightarrow{\Delta m})$ is characterized by the previously proposed gradient e. g. quadratic and root functions and hence we define exemplary functions. We further assume that investments, cash outflows of operational business and savings only depend on the aggregation function $g(\overrightarrow{\Delta m_i})$ with $\overrightarrow{\Delta m_i} = (\Delta m_{i1}, \Delta m_{i2}, \Delta m_{i3})^T$ and hence potential synergies or rivalries between the different dimensions of sustainability within one corporate activity are already considered. Additionally, the cash inflows depend on the total (company-wide, overall corporate activities) sustainability maturity level formalized by aggregation function $f(\overrightarrow{\Delta m})$ with $\overrightarrow{\Delta m} = (\overrightarrow{\Delta m_1}, \dots, \overrightarrow{\Delta m_n})^T$ which aggregates the total sustainability maturity level regarding the synergies and rivalries between different corporate activities.

In the regarded company where we had already defined the current sustainability maturity levels of the corporate activities C_1: Operations ($m_1^{cur} = 1.00$), C_2: Outbound Logistics

$(m_2^{cur} = 1.00)$, and C₃: Infrastructure $(m_3^{cur} = 1.67)$, the experts from different business areas helped us to determine the parameters of the components of the total additional payments surplus $CF(\overrightarrow{\Delta m})$. We assume the functions as shown in Tab II-2.2:

Tab. II-2.2 Continuous Functions based on $\mathbf{m_i^{cur}}$

i	Investment $I_i^{cur}(g(\overrightarrow{\Delta m_i}))$	Cash outflows of operational business $O_i^{cur}(g(\overrightarrow{\Delta m_i}))$	Savings $S_i^{cur}(g(\overrightarrow{\Delta m_i}))$	Cash inflow $E^{cur}(f(\overrightarrow{\Delta m}))$
1	$9 \cdot \Delta m_1{}^2 + 2 \cdot \Delta m_1$	$5 \cdot \Delta m_1{}^2 + 4 \cdot \Delta m_1$	$7 \cdot \Delta m_1{}^{0,5}$	
2	$7 \cdot \Delta m_2{}^2 + 5 \cdot \Delta m_2$	$3 \cdot \Delta m_2{}^2 + 7 \cdot \Delta m_2$	$10 \cdot \Delta m_2{}^{0,5}$	$185 \cdot \sqrt{(f(\overrightarrow{\Delta m}))}$
3	$4 \cdot \Delta m_3{}^2 + 8 \cdot \Delta m_3$	$2 \cdot \Delta m_3{}^2 + 9 \cdot \Delta m_3$	$8 \cdot \Delta m_3{}^{0,5}$	

The calculation of the optimal increase of the sustainability maturity level can be implemented e. g. in Microsoft Excel. For the given company and the regarded circumstances the following results are achieved (rounded values): Δm_1=0.40, Δm_2=0.66 and Δm_3=0.68. The payments surplus is thus 16.88 TEUR. By investing 41.25 TEUR in total, cash inflows of 75.67 TEUR, cash outflows of operational business of 27.77 TEUR, and saving of 10.23 TEUR can be achieved. For the regarded company it is thus economically useful to aim at increasing all of the regarded maturity levels. Here, the biggest potential lies in the corporate activity "infrastructure" – even though this activity is already at a higher maturity level compared to the others.

II.2.5.4   Analysis of the Decision Model Behavior conducting a Sensitivity Analysis

Acquiring reliable real-world data to profoundly examine the benefits of our theoretic approach is rather difficult in the multi-faceted context of sustainability. Furthermore, estimated parameter values and assumptions are generally subject to change and error (Pannell 1997). We therefore analyze the behavior of our decision model regarding sustainability decisions in detail by performing a sensitivity analysis. This is a common method from decision-making theory and aims on examining how sensitive a model's results are to changes in the input variables (Kim et al. 2009; Pannell 1997; Saltelli et al. 2008; Triantaphyllou and Sánchez 1997).

In the basic form of a sensitivity analysis, the value of a certain input parameter is varied within a specific range around the best guess value (see above) while keeping all other input parameters constant (Pannell 1997; Saltelli et al. 2008). In our analysis we change each input

parameter by plus respectively minus 10% compared to its original value estimated by the experts while keeping all other input parameters constant, and repeat this procedure with every input parameter of interest. In order to abstract from the effects that result from the different sizes of the input parameters, we complement the analysis by changing the input parameters in their absolute size by plus respectively minus 1. The major objectives thus are to test the robustness of the decision model's results regarding the parameterization of certain input values and to gain a deeper understanding about the relationships between input parameters and the outcome.

We show the results of the described sensitivity analysis for one exemplary corporate activity (C1: Operations). This restriction is legitimate as the behavior of all corporate activities resembles one another due to the same nature of the underlying functions. The results are presented in Tab. II-2.3. In the first column, we listed the initial values for the input parameters as estimated by the experts (see also Tab II-2.2, first line for corporate activity C1). The subsequent columns contain the changed results according to the variation of the input parameters for the sum over all corporate activities for each of the following components: investments (column 3), cash outflows of operational business (column 4), savings (column 5) and cash inflows (column 6) followed by the resulting total additional payments surplus (column 7), and the respective relative change in the total additional payments surplus (column 8). Each row thereby consists of two sub-rows. The upper sub-row contains the results when the parameter value is increased and decreased by 10% relative to the initial value (column 2). The lower sub-row contains the results of an absolute parameter variation of plus and minus 1 (column 2).

Tab. II-2.3 Sensitivity Analysis

Input parameter: original value	Modified values (+/-10%, +/-1)	Investments	Cash outflows of operational business	Savings	Cash inflows	Resulting total additional payments surplus	Relative change in total additional payments surplus
a: 9	9,9	40,63	26,91	9,96	73,69	16,10	-5%
	8,1	41,76	28,83	10,53	77,89	17,84	6%
	10	40,56	26,82	9,93	73,48	16,03	-5%
	8	41,80	28,96	10,56	78,16	17,96	6%
b: 2	2,2	41,21	27,70	10,20	75,50	16,79	0%
	1,8	41,28	27,85	10,25	75,83	16,95	0%
	3	41,06	27,40	10,11	74,83	16,49	-2%
	1	41,40	28,16	10,34	76,50	17,28	2%
j: 5	5,5	40,50	27,69	10,07	74,54	16,42	-3%
	4,5	42,09	27,79	10,39	76,87	17,38	3%
	6	39,83	27,55	9,93	73,48	16,03	-5%
	4	43,04	27,72	10,56	78,16	17,96	6%
k: 4	4,4	41,02	27,78	10,18	75,33	16,71	-1%
	3,6	41,48	27,76	10,27	76,00	17,03	1%
	5	40,69	27,77	10,11	74,83	16,49	-2%
	3	41,83	27,73	10,34	76,50	17,28	2%
r: 7	7,7	41,66	28,04	10,59	76,26	17,16	2%
	6,3	40,84	27,51	9,86	75,07	16,58	-2%
	8	41,83	28,15	10,75	76,51	17,28	2%
	6	40,67	27,39	9,71	74,82	16,46	-2%
s: 185	203,5	52,16	34,87	12,28	99,96	25,20	49%
	166,5	30,66	20,78	8,03	53,51	10,10	-40%
	186	41,83	28,15	10,34	76,93	17,28	2%
	184	40,67	27,39	10,11	74,41	16,46	-2%

The conducted analysis allows us to draw the following conclusions:

- The direction of the changes of the total additional payments surplus is as expected from an analytical point of view: an increase (decrease) of the cash outflows leads to a decrease (increase) of the total additional payments surplus and vice versa for the cash inflows. Here, increased (decreased) savings or increased (decreased) cash inflows lead to an increased (decreased) total additional payments surplus.

- Furthermore, the result of our decision model is quite robust for our real-world example: The relative change in the total additional payments surplus is generally small and considerably lower than the 10% variation of the respective input parameter except for the case of the expected cash inflows. Here, the variation of *s* by +/- 10% results in a 49% (-40%) increase (decrease) of the total additional payments surplus. This can be explained by the high absolute value of the input parameter *s* compared to all other input parameters. One reason might be the fact, that in contrast to all other input parameters, the cash inflows are the only component in our example that depends on the aggregated total sustainability maturity level (aggregation function $f(\overrightarrow{\Delta m})$) over all corporate activities, whereas the other input parameters only contain the effects of just one corporate activity (aggregation function $g(\overrightarrow{\Delta m_i})$). Another reason to justify this comparably high value of the cash inflows is the fact that the customer equity which is the main building block of this cash flow component is a future-oriented figure that includes long-term effects.

In order to abstract from this relative size effect, we furthermore examined the absolute variation of the input parameters (the lower two sub-rows for each input parameter in table II-2.3). The same absolute variation of +/- 1 for all input parameters results in a similar low variation of the total additional payments surplus (column 7 and 8). This also holds true for the variation of the input parameter s (variation of the total additional payments surplus of + 2%/-2%).

Hence, when estimating the cash inflows, special attention has to be paid to the consequences of misestimating long-termed effects like customer-related issues, as these can be higher than rather short-termed ones. Moreover, as the cash inflows depend on the aggregated function over all corporate activities, these can be higher than the other components that only focus on single corporate activities and consequently have a considerable stronger effect on the model results.

In the previous analysis we only focused on the variation of the input parameters of one corporate activity (C_1: Operations) within the three examined corporate activities. As the same experts were asked to assess the current state of sustainability for all corporate activities, this restriction on one corporate activity is legitimate. Even more, the direction of effects on the model output remains the same independently of the considered corporate activity due to the equal nature of their underlying functions. However, when estimating the input parameters it is possible that the experts over- or underestimate not just one, but for example the same input parameter for all corporate activities at the same time, which consequently leads to stronger effects regarding the change of the output. Moreover, in order to consider that humans in dependence of their attitude towards risk tend to be rather optimistic or pessimistic regarding future cash flows, we applied one optimistic and one pessimistic scenario besides the presented base case scenario to further complement the analysis. We deduce the values for the optimistic and pessimistic scenario as follows: in the optimistic case, we expect the experts to underestimate the investments and cash outflows of operational business while overestimating the cash inflows and savings at the same time by 10% each for all three examined corporate activities. For the pessimistic case, we expect the experts to overestimate the investments and cash outflows of operational business while underestimating the cash inflows and savings by 10% each for all three examined corporate activities. Tab II-2.4 summarizes the results of this scenario analysis.

Tab. II-2.4 Scenario Analysis

Base case (original input parameters)						Investments	Cash outflows of operational business	Savings	Cash inflows	Resulting total additional payments surplus	Relative change in total additional payments surplus
9	2	5	4	7	185						
7	5	3	7	10	185	41,25	27,77	10,23	75,67	16,87	
4	8	2	9	8	185						
Optimisitc case (underestimation of cash outflows, overestimation of cash inflows)											
8,1	1,8	4,5	3,6	7,7	203,5						
6,3	4,5	2,7	6,3	11	203,5	62,42	41,29	16,71	123,63	36,63	117%
3,6	7,2	1,8	8,1	8,8	203,5						
Pessimistic case (overestimation of cash outflows, underestimation of cash inflows)											
9,9	2,2	5,5	4,4	6,3	166,5						
7,7	5,5	3,3	7,7	9	166,5	21,74	14,81	4,97	36,80	5,23	-69%
4,4	8,8	2,2	9,9	7,2	166,5						

We can see that the relative change in the total additional payments surplus is quite substantial (+117% and - 69%). This can be explained by the fact that compared to the analysis presented above where we focused on just one input parameter at a time, now all eighteen input parameters are misestimated by 10 % each at the same time. In the pessimistic scenario, the total additional payments surplus decreases only by 69%, which is quite low compared to the increase of 117% in the optimistic case. We can thus see that in our current case, a pessimistic estimation of cash in- and outflows leads to a lower change of the total additional payments surplus than an overly optimistic estimation of the respective input parameters does. When taking into account other current sustainability maturity levels for the corporate activities other results may be obtained and other conclusions can be drawn. This can be explained by the following: Depending on the gradient of the convex cash outflow and concave cash inflow functions and the respective starting point on the functions (i. e. current sustainability maturity levels) the same relative change of the input parameters for cash in- and outflows can lead to different results regarding the strength of the change on the output.

In the regarded case, the base case scenario is characterized by the fact that it is economically useful to aim at increasing all of the regarded maturity levels (i. e. current maturity levels located on the left side of the optimum). Hence, the underestimation of the convex cash outflows (leading to a lower gradient of the curve) and the overestimation of the concave cash inflows (also leading to a lower gradient of the curve) lead to a higher value of the total additional payments surplus in the optimum (optimistic case). In contrast, in the pessimistic case, both gradients of the functions increase, causing that the optimum for the estimated parameter values is reached with a lower increase in maturity levels than in the optimistic case.

The results of the presented analysis can build the basis for the transformation towards sustainability in the regarded company. Altogether, the proposed *Sustainability Maturity Cube*

as a blueprint, as well as the adapted decision model of Kamprath and Röglinger (2011) created utility for the subject matter experts as they provided them with recommendations and means for further analysis (e. g. careful estimations, short-termed vs. long-termed effects, effects of different absolute sizes of input parameters). They also helped to systematize the decision processes. The presented approach thus allows aligning ecological, social, and economic objectives and drawing economically reasonable conclusions in this context by determining the optimal increase of the sustainability maturity level.

II.2.6   Contribution, Limitations, and Conclusion

In order to maintain our current style of life, we would need the equivalent of two of our today's planets by 2030 (Buhl and Jetter 2009). Statements like this and the knowledge of scarce resources as well as the existence of more and more sensible customers (for example LOHAS) emphasize the necessity to integrate sustainable behavior into individual and corporate activities and decisions. Although it bears great potential for economic improvement, still little research exists in the field of the comprehensive concept of sustainability and how companies should engage in sustainability transformations.

With the presented *Sustainability Maturity Cube* as a blueprint and the decision model at hand, we contribute to theory and practice: It was our objective to integrate ecological, social, and economic objectives into corporate decisions. We first showed how organizations can structure the field of action, and suggested possible starting points within corporate processes where to implement sustainability actions (via analyzing the entire business system following Porter's value chain model) for all three dimensions of sustainability. Since implementing sustainability is characterized by continuous development, we adapted the basic idea of stages of development and maturity to sustainability context, in order to provide a possibility to describe the respective sequence of levels that form an anticipated path from an initial state to maturity. The resulting *Sustainability Maturity Cube* is a blueprint that is based on acknowledged scientific concepts to support the systematic improvement of sustainability management by considering certain corporate activities, the three dimensions of sustainability, and the corresponding stages of development (Research Question 1). Being a blueprint, it can be instantiated and hence provides the basis for developing concrete sustainability maturity models.

The second contribution is the proposed decision model that allows identifying the economically optimal increase of the sustainability maturity level of each identified corporate activity and each dimension of sustainability respectively (Research Question 2). Our

approach thereby represents a first step to align decisions regarding the transformation towards sustainability with the paradigm of value-based management, taking into account the ambiguous role of the economic dimension in business context. Finally, the instantiation of the blueprint and the applicability of the decision model were illustrated by the example of a German medium-sized company and tested for its robustness, performing a sensitivity analysis. Overall, the approach delivers a contribution to theoretical and practical knowledge in the multidisciplinary research field of transformation towards sustainability and, in parallel, offers a basis or starting point for further research.

Besides the previously highlighted benefits, our approach offers scope for discussion and implicates limitations:

- The difficulties regarding a clear definition, understanding and operationalization of (corporate) sustainability show that sustainable development is a complex and multidimensional issue. Hence, a clear and unambiguous managerial advice cannot be given. The understanding of corporate sustainability in this paper is based on the belief that the economic perspective is of particular importance in a business context and can be seen as ambiguous. On the one hand, it is one of the three sustainability dimensions, but at the same time – in conformity with the paradigm of value-based management emerges as an additional organizational incentive when engaging in sustainability transformation. This explains the understanding of corporate sustainability for this work, however, future research needs to further dispute this controversy.

- The empirical evidence of whether all customers care about sustainability issues and express their concerns through purchasing behavior and thus price sensitivity is debatable. Even those customers, who say they care about sustainability, do not necessarily reflect their attitude in their purchasing habit (Bonini and Oppenheim 2008; Bellows et al. 2008; Fisher 1993; Pickett-Baker and Ozaki 2008). As a consequence sustainable practices may directly and negatively affect profitability, and organizations may refrain from diving into adopting sustainable practices.

- Determining the concrete monetary values of the consequences of sustainability actions is not straightforward as there does not always exist a metric that can be estimated: In some cases one of the numerous frameworks of sustainability assessment can provide assistance in determining such sustainability metrics but this may not be always reliable. Hence, some of the values depend on the estimation of subject matter experts. An objectification is desirable but would require further research.

- There are several issues that have to be considered when instantiating a concrete sustainability maturity model, such as the determination of current and targeted sustainability maturity levels, the formulation of concrete development paths from initial to desired maturity levels, confounding effects (e. g. when implementing several actions at the same time), and situations when it makes sense to invest in a particular action or not. We addressed some of these aspects in the operationalization of the approach, however further research needs to focus on guidelines for the operationalization of the *Sustainability Maturity Cube*.

- Future research should also focus on a more extensive evaluation of the proposed approach as we only used an illustrative case for the operationalization. Even though this case allows for an initial instantiation of the *Sustainability Maturity Cube*, the findings are not aimed at making generalizations.

These limitations provide room for further research in this area. Nevertheless, our approach delivers insights in the assessment of sustainability and may serve as a first step towards integrating sustainability into organizations and corporate decision-making.

II.2.7   Appendix

Tab. II-2.5 Tools and Management Approaches for the Integration of Sustainability into Organizations

	Approach	Description	Strengths	Weaknesses
Quality and Environmental Management Systems	ISO 14000	Standards related to environmental management to help organizations on how to minimize negative effects of their operations (processes etc.) on the environment.	•High conformance with legislative and regulatory requirements. •Internationally recognized standard.	•Lack of measurement and evaluation of environmental performance against objectives and targets. •Lack of employee involvement.
	ISO 9000	Standards related to quality management systems designed to help organizations ensuring that they meet the needs of customers and other stakeholders while meeting statutory and regulatory requirements related to the product.	•Comprehensive model for quality management systems.	•Time and labor intensive registration process.
	EMAS (Eco-Management and Audit Scheme)	Voluntary environmental management instrument to assess, manage and continuously improve environmental performance.	•Globally applicable and open to all types of private and public organizations. •Environmental performance can be reviewed and tracked regularly. •The use of indicators allows for consistent monitoring and reporting.	•Social implications are not considered.
Environmental Management Tools	GRI Guidelines	Guidelines that assist reporting organizations and their stakeholders in articulating and understanding contributions of the organization to sustainable development through their reports.	•Holistic framework that addresses social, environmental and economic performance. •Globally applicable and open to all types of private and public organizations. •Allows to measure and benchmark performance, both against own targets and externally.	•Labor intensive implementation process. •Guidance, but not accreditation unless combined with other tools, such as an assurance standard.
	Environmental accounting	Incorporation of both economic and environmental information into accounting.	•Complete costs (including environmental remediation and long-term environmental consequences and externalities) can be quantified and addressed.	•Social implications are not considered.
	Life-cycle Assessment	Technique to assess environmental impacts associated with all stages of a product's life cycle.	•Holistic assessment of environmental impact.	•Social implications of products are not considered.

			•Identification of environmental consequences.	
	Environmental Reporting	Systematic and holistic statement of environmental burden and environmental efforts in organizations' activities.	•Strengthening voluntary environmental efforts in organizations activities.	•Social implications are not considered.
	Sustainable (Product) Design	Design with the intention to eliminate negative environmental impact completely through skillful, sensitive design.	•Creation of meaningful innovations that can shift behavior.	• Lack of measurement and evaluation of environmental performance against objectives and targets.
	Green Marketing	Marketing of products that are presumed to be environmentally safe.	• Involvement of the customer • Raises awareness for environmental consequences.	•Misleading or overstated claims can lead to regulatory or civil challenges. •Risk of "greenwashing".
Social Management Tools	AA1000	Development of tools that enable individuals, institutions and alliances to respond better to global challenges.	•Development in a multi-stakeholder process. •Compatibility with other sets of principles in the marketplace, such as the UN Global Compact, GRI and ISO 26000.	
	SA8000	International standardized code of conduct for improving working conditions around the world.	•Principles of thirteen international human rights conventions build the basis. • Development in a multi-stakeholder process. •Provision of public report of good practice to consumers, buyers, and other companies.	•Environmental implications are not considered.
	Social Auditing	Approach to reporting a firm's activities which stresses the need for the identification of socially relevant behavior, the determination of those to whom the company is accountable for its social performance and the development of appropriate measures and reporting techniques.	• Raises awareness for social consequences.	•Environmental implications are not considered. • Lack of measurement and evaluation of environmental performance against objectives and targets.

Measurement Tools	Sustainability Balanced Scorecard	Incorporate environmental and social aspects into the main management system of a firm.	•Overcomes the shortcomings of conventional approaches to environmental and social management systems by integrating the three pillars of sustainability into a single and overarching strategic management tool. •Allows for the measurement and evaluation of environmental performance against objectives and targets.	• Specification for application in individual company is necessary in order to achieve targeted actions.
	Sustainability Maturity Models	Sustainability maturity models can be used to objectively evaluate a company's initial and evolving states with regards to sustainability and give organizations a vital tool to manage their sustainability capability.	•Holistic framework that addresses social, environmental and economic dimension of sustainability.	• Current state and target state have to be identified in advance •Focus on sustainability measures rather than on products or services •Specification for application in individual company is necessary in order to achieve targeted actions
Applied Concepts	Green Supply Chain	Extension of traditional supply chains to include activities that aim at minimizing environmental impacts of a product throughout its entire life cycle, such as green design, resource saving, harmful material reduction, and product recycle or reuse.	•Raises awareness for environmental consequences of a product. •Consideration of the entire life cycle	•Social implications are not considered.
	Sustainable Tourism	Attempt to minimize impact on the environment and local culture, while helping to generate future employment for local people. The aim of sustainable tourism is to ensure that development brings a positive experience for local people, tourism companies and the tourists themselves.	•Holistic framework that addresses social, environmental and economic dimension of sustainability	• Limited application area
	Sustainable Infrastructure	Sustainable infrastructure refers to the design, building, and operating of structural elements in ways that do not diminish the social, economic and ecological processes required maintaining human equity, diversity, and the functionality of natural systems.	•Holistic framework that addresses social, environmental and economic aspects.	•Limited application area

	Sustainable Customer Relationship Management	Holistic integration of economic, environmental, and social sustainability issues into the strategic, operational, and analytical areas of CRM	•Holistic framework that addresses social, environmental and economic performance.	•Limited application area

Tab. II-2.6 Exemplary Range of different Sustainability Maturity Models found in Research and Practice with respective core Application Area (second Line) and according Definitions regarding Sustainability Maturity Levels (Lines three to seven)

Maturity Level	Cagnin, Loveridge, and Butler, 2011	Kirkwood, Alinaghian, and Srai, 2008	Zarnekow and Erek, 2008	Object Management, Group 2009	Silvius and Schipper, 2010	Mani, Lyons, and Sriram, 2010	Curry and Donnellan, 2012
Application Area	Business	Supply Networks (network design)	Information Management	Business	Project Management	Manufacturing	Information and Communication Technology
1	Ad hoc	Accidental/ Initial	Ad hoc	Ad hoc	not existing	Initial	Initial
2	Planned in Isolation	Repeatable	Conscious	Defined, Documented and Architected	Resources	Repeatable	Basic
3	Managed with No Integration	Defined	Established	Repeatable and Governed	Business Processes	Defined	Intermediate
4	Excellence at Corporate Level	Managed	Quantitatively controlled	Optimized and extensible	Business Model	Quantitatively managed	Advanced
5	High Performance Sustainability Net	Mastered/ Optimized	Optimized	Demonstrable ROI of Green Initiatives	Products and Services	Optimizing	Optimizing

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II.3 Research Paper 3: "Zählen, wiegen, messen – IT Transformationen erfolgreich steuern"

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Zusammenfassung:

IT-Transformationsprojekte sind die Mammuts unter den IT-Vorhaben. Anhand der etablierten Steuerungsmechanismen eines erfolgreichen IT-Transformationsprojekts im Finanzdienstleistungssektor zeigt dieser Erfahrungsbericht, welche Herausforderungen an eine zentrale Projektsteuerung bestehen und warum diese gegenüber föderalen Ansätzen vorteilhaft ist. Konkrete Praxisbeispiele verdeutlichen dabei, warum Kriterien wie intersubjektive Vergleichbarkeit oder Aggregations- bzw. Disaggregationsfähigkeit elementar wichtig sind, welche Dimensionen und Indikatoren sich zur Steuerung bewährt haben und wie eine Operationalisierung auch ohne teure Spezialsoftware gelingt.

Schlüsselwörter: *Eigenschaften einer IT-Transformation, Struktur einer IT-Transformation, Zentrale Projektsteuerung, Bewertungsdimensionen, Steuerungsparameter, Intersubjektive Vergleichbarkeit, Aggregationsfähigkeit*

II.3.1   Eigenschaften und Herausforderungen von IT-Transformationen

Ausgangspunkt und Basis dieses Erfahrungsberichts ist die IT-Transformation eines Finanz-dienstleisters, dessen historisch gewachsene und durch Unternehmenszukäufe stark heterogene Anwendungslandschaft durch zahlreiche Schnittstellen zwischen teilweise veralteten Systemen gekennzeichnet war. Ziel der Transformation war die Konsolidierung und Homogenisierung dieser siloartigen Anwendungslandschaft durch konsequente Ausrichtung an serviceorientierten Architekturen (SOA) über die Einführung einer eigenentwickelten Middleware. Zudem erfolgte die Konsolidierung sämtlicher Kernbanksysteme, die vorher teils auf unterschiedlichen Plattformen liefen, auf SAP Standardanwendungen. Die IT-Transformation star-tete im Jahr 2008 und konnte zum September 2013 erfolgreich abgeschlossen werden.

Im Allgemeinen stellen IT-Transformationen wie die eben beschriebene eine große Herausforderung für Unternehmen dar. Aspekte, die als Ursache für das Scheitern von (IT-) Projekten aufgeführt werden, gewinnen vor dem Hintergrund dieser Mammut-Projekte weiter an Bedeutung. Zu nennen sind Themen wie die Komplexität von Projektinhalten, unklare Rollenverteilungen, Anforderungen und Ziele, mangelhafte Kommunikation oder fehlendes Projektmanagementwissen und -methodik auf Führungsebene [Wieczorrek und Mertens 2008]. Bedingt durch diverse Eigenschaften von IT-Transformationsprojekten, werden einige der genannten Gefahren in diesem Projektumfeld verstärkt. IT-Transformationen sind Projekte, die die Definition dieses Begriffs im Sinne eines einmaligen Vorhabens mit Zielen, beschränkter Laufzeit, beschränktem Budget und Ressourcen weit ausdehnen (vgl. [Schulte-Zurhausen 2010], [Wieczorrek und Mertens 2008]). Projektlaufzeiten erstrecken sich oftmals über mehrere Jahre und das finanzielle Projektvolumen liegt meist im zwei bis dreistelligen Millionenbereich. Eine hohe Anzahl betroffener Geschäftsanwendungen innerhalb der Anwendungslandschaft wie auch eine große Zahl beteiligter interner wie externer Mitarbeiter sowie Dienstleister und Lieferanten prägen das Projektbild und tragen zum hohen Risiko dieser Vorhaben bei.

Um den Gefahren effektiv entgegen zu treten, kann eine zentrale Projektsteuerung den Schlüssel zum Erfolg darstellen. Begründet liegt dies in mehreren Faktoren: Ein wesentliches Argument sind die starken Abhängigkeiten zwischen den zahlreichen Einzelprojekten einer IT-Transformation. Einzelne Vorhaben und Teilschritte müssen für den Erfolg der Gesamttransformation jederzeit aufeinander abgestimmt sein, um einerseits vorhandenes Synergiepotenzial zu erkennen und zu nutzen und andererseits Dominoeffekte, die

beispielsweise durch eine zeitliche Verzögerung von Teilschritten entstehen können, frühzeitig zu erkennen und zu vermeiden (vgl. kritischer Pfad [Wieczorrek und Mertens 2008]. Ein weiterer kritischer Faktor sind Budgetmehrbedarfe. In Folge des hohen Projektvolumens führen bereits kleine Zielabweichungen in Einzelprojekten zu hohen nominalen Mehrbedarfen. Daher ist, vor allem hinsichtlich der aggregierten Sicht aller Abweichungen über alle Teilprojekte, eine rigide Budgetsteuerung erforderlich. Nicht zuletzt genießen Projekte dieser Größenordnung und Relevanz für das originäre Geschäft von Unternehmen (vgl. operationelle Risiken von Systemaus-fällen) eine hohe Sichtbarkeit im Unternehmensvorstand, Aufsichtsrat, aber auch gegebenen-falls bei externen Organen, wie beispielsweise der Bundesanstalt für Finanzdienstleistungsaufsicht (BaFin) oder der Bundesbank (BuBa) im Falle von IT-Transformationen im Bankensektor. Die daraus resultierende Aufmerksamkeit hinsichtlich des Projektstatus und -erfolgs erfordert ein konsistentes und anschlussfähiges Reporting, das jederzeit und unter Umständen auch sehr kurzfristig und ohne hohe Abstimmungsbedarfe aussagefähig sein muss. Föderale Strukturen reichen aufgrund der genannten Eigenschaften von IT-Transformationen für diesen geforderten Gesamtüberblick nicht aus. Eine Gesamtbudgetsicht, die Organisation der gesamten Projektressourcen oder die Steuerung von Abhängigkeiten zwischen den einzelnen Teilprojekten kann nur durch eine zentrale Instanz ganzheitlich vorgenommen und erfasst werden. Abbildung II-3.1 fasst die Eigenschaften von IT-Transformationen nochmals zusammen und zeigt die damit verbundenen Herausforderungen an eine zentrale Projektsteuerung auf.
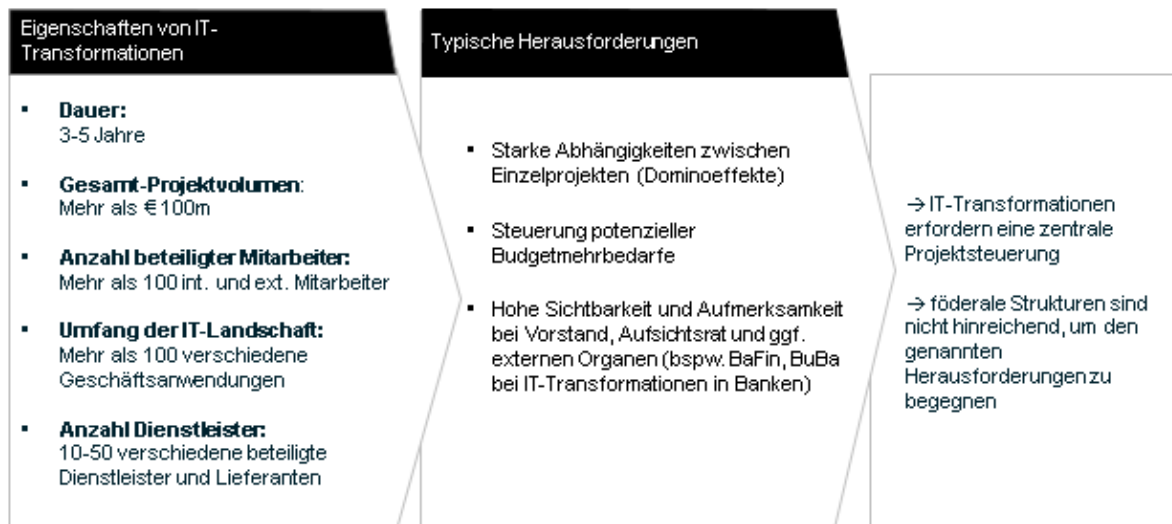
Abbildung II-3.1: Eigenschaften von IT-Transformationen

II.3.2   Die typische Struktur einer IT-Transformation

Um im Weiteren die Anforderungen an eine erfolgreiche Projektsteuerung herauszuarbeiten, wird zunächst die typische Struktur von IT-Transformationen anhand des dem Beitrag zugrundeliegenden Beispiels vorgestellt (vgl. Abbildung II-3.2).
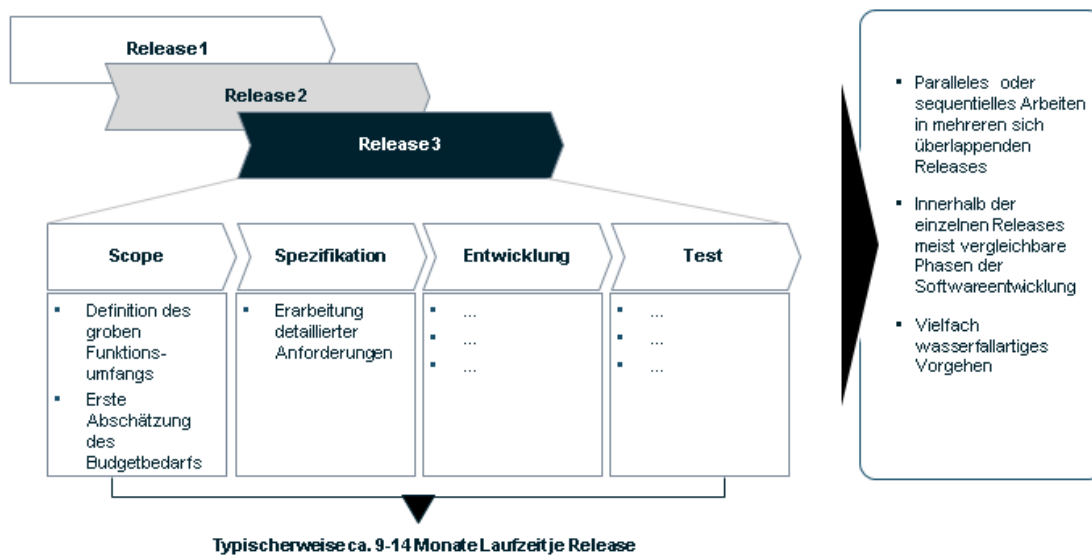
Abbildung II-3.2: Typische Struktur und Vorgehensweise bei IT-Transformationen

Das IT-Transformationsvorhaben wurde in fünf Teilabschnitte zerlegt, um dadurch die Komplexität und damit auch das Risiko, das mit einer sehr langen Projektlaufzeit einhergeht, zu verringern. Die fünf Teilabschnitte, im Folgenden als Releases bezeichnet, wurden zeitlich sequentiell, bzw. stellenweise überlappend durchgeführt. In jedem Release waren Teilprojekte des Gesamtvorhabens gebündelt. Ein Release hatte dabei in der Regel eine Laufzeit zwischen

neun und vierzehn Monaten und lieferte ein Ergebnis, wie zum Beispiel die Einführung der Middleware als Teilschritt zur Gesamttransformation. Die Gestaltung der Releases erfolgte nach den Phasen der Softwareentwicklung, meist vergleichbar für alle Releases, die sich in die Scope-Phase (Abgrenzungsphase), die Spezifikationsphase, die Phase der Entwicklung und schließlich des Tests gliederten. Dabei wurde vielfach ein an das Wasserfallmodell angelehntes Vorgehen gewählt (vgl. Vorgehensmodelle in der IT-Entwicklung, [Ruf und Fittkau 2007]).

In der Scope-Phase erfolgte die erste Schätzung des groben Funktionsumfangs eines Releases auf Basis von „Top Level Requirements" (TLRs). Zudem wurde eine erste Abschätzung des Budgetbedarfs erhoben. In der darauffolgenden Spezifikationsphase erfolgte die weitere Detaillierung der Anforderungen resultierend in sogenannten „Mid Level Requirements" (MLRs), wie auch die Detaillierung des Budgets. In beiden Phasen waren sowohl Verantwortliche der Fachseite wie auch der IT-Seite beteiligt, um die Projektanforderungen aus beiden Perspektiven zu erstellen und zu validieren. Diese duale Besetzung der Teams, durch Fach- und IT-Seite wurde auch auf Ebene der Leitungsfunktionen in den Teil- und Unterprojekten sowie auf oberster Ebene der Projektsteuerung vorgenommen. In der Entwicklungsphase erfolgte die Umsetzung teils in agiler Entwicklung innerhalb mehrerer IT-Entwicklungsplattformen. Diese bündelten die Entwicklungsarbeiten an einer Applikation wie beispielsweise der Middleware oder aller Applikationen eines Funktions- oder Anwendungsbereichs, wie zum Beispiel Front-Office oder Back-Office-Systeme. Die Entwicklungsplattformen waren den jeweiligen Teilprojekten eines Releases orthogonal zugeordnet, d.h. eine Plattform lieferte gleichzeitig an mehrere Teilprojekte, wobei jede Plattform einen IT-seitigen Leiter („Platform-Head") hatte, der die Zulieferungen an die Teilprojekte koordinierte und verantwortete. Das Ergebnis der Entwicklung in den Teilprojekten wurde im Rahmen der Testphase wiederum fach- wie auch IT-seitig hinsichtlich Funktionalität und Erfüllung der Anforderungen überprüft. Die duale Besetzung der Teams und Leitungsfunktionen durch Fach- und IT-Seite, wie auch das iterative Vorgehen in den einzelnen Releases sicherte dabei, dass die formulierten Anforderungen inhaltlich sowie qualitativ dem entsprachen, was tatsächlich von der Fachseite benötigt wurde und die gelieferten Softwareartefakte diese wiederum auch erfüllten.

II.3.3   Schlüsselanforderungen an eine erfolgreiche Steuerung

Welche Anforderungen muss eine erfolgreiche Projektsteuerung nun erfüllen, um die vorgestellte IT-Transformation über alle Releases hinweg zentral zu führen? Zwei wesentliche

Elemente haben sich hierzu aus dem vorliegenden Praxisbeispiel abgeleitet. Einerseits gab es verschiedene Anspruchsgruppen auf verschiedenen Ebenen, innerhalb und außerhalb des Projekts und/oder des Unternehmens, die Informationen zum Projektstatus einforderten. Andererseits gab es verschiedene Projektbeteiligte, die wiederum diese Information zum Projektstatus abgaben. Nachfolgende Beispiele sollen die daraus folgenden wesentlichen Anforderungen an die Projektsteuerung verdeutlichen: *Der CIO muss dem Vorstand eine Einschätzung dazu geben, ob eine hinreichende Testabdeckung zum geplanten Go-Live Termin erreicht werden kann. Ein Release-Manager hingegen muss auf Wochenbasis einschätzen können, ob alle Projekte eines Releases rechtzeitig zum Integrationstest die erforderliche Software liefern können.* Status-Reports jeglicher Granularitätsebene (vgl. Teilprojekt-, Release-, oder Gesamtprojektebene) mussten folglich effizient, schnell und ohne aufwändige Abstimmungsprozesse mit vielen betroffenen Projektmitarbeitern erstellt werden können. Um das zu erfüllen mussten die Steuerungsparameter einfach zu aggregieren sein (z.B. additiv), um so jederzeit den Anspruchsgruppen Auskunft zum Projektstatus geben zu können. Wie aber sieht diese Auskunft aus, wenn unterschiedliche Projektteilnehmer diese abgeben? *Der Programm-Manager muss beispielsweise einschätzen, ob der vom Kreditrisikobereich als kritisch eingeschätzte Zustand tatsächlich besorgniserregend oder nur Ergebnis der potenziell starken Risikoaversion des Bereichs ist. Der Projektleiter im Bereich der Handelssysteme hingegen will verstehen, ob die optimistische Einschätzung der Entwickler über die Effizienz der Fehlerbehebung wirklich gerechtfertigt ist – oder aber vergleichsweise positiv gesehen wird, da die beteiligten Projektteilnehmer tendenziell risikofreudig sind.* Die Parameter der Projektsteuerung mussten folglich so gewählt werden, dass sie eine intersubjektive Vergleichbarkeit zulassen. Das heißt anders formuliert, sie sollten eine objektive Einschätzung des Zustands ermöglichen, die nicht, beziehungsweise nur in geringem Maße von der individuellen Risikopräferenz der verantwortlichen Projektleiter bzw. -beteiligten abhängig ist. In der Praxis der Projektsteuerung findet man häufig freitextartige Statusberichte. Diese erfüllen die genannten Schlüsselanforderungen der Aggregationsfähigkeit und intersubjektiven Vergleichbarkeit nicht. Im Gegenteil: freitextartige Statusberichte können diese vielmehr erschweren. Zusammenfassungen durch dritte Personen können den Inhalt verfälschen oder wichtige Aspekte des Projektstatus werden weg gelassen. Zudem spiegeln die gewählten Formulierungen die Risikopräferenz des Erstellenden wider und lassen so keine objektive Beurteilung des Projektstatus zu. Eine Steuerung auf Basis von quantitativen Steuerungsgrößen kann diesem jedoch entgegen wirken.

II.3.4   Zählen, wiegen, messen: Kernindikatoren der erfolgreichen Steuerung

Die Erfahrungen aus der dem Beitrag zugrunde liegenden IT-Transformation bestätigen den Erfolg einer Projektsteuerung, die sich auf einige wenige, in den einzelnen Release-Phasen wiederkehrende, quantitative Steuerungsgrößen fokussiert. Drei Dimensionen haben sich dabei bewährt: Budgetverbrauch, Projektfortschritt und Projektqualität. Jede dieser Bewertungs- oder Steuerungsdimensionen wurde auf die jeweiligen Phasen innerhalb der Releases angepasst. Während der Budgetverbrauch über alle Phasen hinweg einheitlich gemessen wurde, wurden Projektfortschritt wie auch -qualität entsprechend den Ergebnissen der einzelnen Phasen angepasst. Abbildung II-3-3 liefert eine Übersicht.

| Release-Phasen | Dimensionen der Steuerung | | |
	Budgetverbrauch	Fortschritt	Qualität
Scope / Spezifikation	▪ Laufende Zeiterfassung aller Mitarbeiter, deren geleisteter Aufwand aus dem zur Verfügung stehenden Budget zu finanzieren ist ▪ Erfassung in einer Form, die weitere Aggregation zulässt (bspw. keine physischen Stundenzettel) ▪ Kontinuierliche Extrapolation der „Burn-rate" zur frühzeitigen Identifikation potenzieller Budgetüberschreitungen	▪ Messung des Fortschritts anhand des Zustands von konkreten zu liefernden Artefakten ▪ Definition von zwei bis drei Versionszuständen (bspw. Version 1.0 ist die von IT und Fachbereich abgenommene Version) hat sich bewährt	▪ Messung der Review-Monita der Lieferartefakte, deren Kritikalität und Abarbeitungszustand
Entwicklung		▪ Frühzeitige Definition von Lieferartefakten mit sinnvoller Größe ▪ Messung der Anzahl fertiger Artefakte (statt des verbrauchten Aufwands)	▪ ./.
Test		▪ Abarbeitungszustand der Testfälle im Zeitablauf und Erfolgsmessung je Testfall	▪ Messung der Anzahl dokumentierter Fehler und Einordnung der Fehler in vordefinierte und homogene Fehlerklassen

Abbildung II-3.3: Dimensionen der Projektsteuerung in den Release-Phasen

Der Budgetverbrauch wurde anhand der laufenden Zeiterfassung aller Mitarbeiter, deren geleisteter Aufwand aus dem zur Verfügung stehenden Budget zu finanzieren ist, gemessen. Die Erfassung erfolgte dabei in einer Form, die eine weitere Aggregation der Daten zulässt, konkret durch die Erfassung geleisteter Projektstunden, die zentral gepflegt wurden (keine physischen „Stundenzettel"). Es erfolgte zudem eine kontinuierliche Extrapolation der „Burn-Rate" (tatsächlicher Budgetverbrauch) gemeinsam mit einem stetigen Soll-Ist-Vergleich, um potenzielle Budgetüberschreitungen frühzeitig identifizieren zu können. Der Budgetverbrauch wurde in allen Release-Phasen und über alle Releases hinweg auf gleiche Art und Weise erfasst. So war jederzeit eine Aggregation bzw. Disaggregation dieser Bewertungsdimension möglich. Die Anforderung der Aggregationsfähigkeit der Steuerungsgröße war folglich erfüllt. Durch die quantitative (vgl. Stundenanzahl) und

monetäre (vgl. geschätztes Budget, tatsächlich verbrauchtes Budget) Erfassung ist zudem eine unabhängige und intersubjektiv vergleichbare Aussage möglich.

Der Projektfortschritt wurde mit Hilfe der Anzahl und des Fortschritts von zu liefernden Artefakten erfasst. In der Scope- und Spezifikationsphase erfolgte dies anhand des Zustands der zu liefernden Artefakte. Bewährt hat sich hier die Definition von zwei bis drei Versionszuständen. Die Version 1.0 ist dabei beispielsweise die vom Fachbereich und der IT abgenommene finale Version. In der Entwicklungsphase erfolgte die Messung über die Anzahl der fertiggestellten Artefakte (statt des verbrauchten Aufwands). Diese mussten dazu bereits frühzeitig und in jeweils sinnvollem Größenumfang definiert werden. In der Testphase wurde der Projektfortschritt anhand des Abarbeitungszustands der Testfälle im Zeitablauf und durch die Erfolgsmessung je Testfall gemessen. Wiederum erfüllen die gewählten Indikatoren die Anforderungen der Aggregationsfähigkeit und intersubjektiven Vergleichbarkeit an die Projektsteuerung durch die Wahl eines quantitativen Steuerungsparameters. So gibt die Anzahl aller fertiggestellten Softwareartefakte eine von der Risikoeinstellung des Berichterstattenden nahezu unabhängige Einschätzung des Projektfortschritts, die von jedem Informationsempfänger gleich und auch unabhängig von dessen Risikopräferenz eindeutig aufgefasst werden kann (die Konsequenz aus der Information und damit Einschätzung der Situation ist dann freilich die subjektive Wahrnehmung des Entscheiders). Zudem ist, sofern sinnvoll und benötigt, eine beliebige Zusammenfassung der Daten, wie beispielsweise Anzahl der Testfälle eines Teilprojekts versus Anzahl der Testfälle aller Projekte innerhalb eines Releases, je nach Interesse und Berichtsebene des Informationsempfängers möglich.

Die Projektqualität wurde für die Phasen Scope und Spezifikation anhand der Messung der „Review-Monita" (Beanstandungen, die im Zuge der Überprüfung gefunden wurden) der jeweiligen Lieferartefakte, deren Kritikalität und Abarbeitungszustand gemessen. Alle gefundenen Monita wurden dabei zentral erfasst, Verantwortlichkeiten festgelegt und auch der zugehörige Status dokumentiert. In der Entwicklung erfolgte die Erfassung der Qualität nur innerhalb der jeweiligen Entwicklungsplattformen über sogenannte „Bug-Tracker". Dies diente der internen Steuerung je Plattform und wurde nicht zentral erfasst. In der Testphase erfolgte die Erhebung der Projektqualität wiederum zentral, über die Messung der Anzahl der dokumentierten Fehler und deren Einordnung in Fehlerklassen. Vorausgesetzt einer eindeutigen Definition dieser Kritikalitätsklassen, lässt auch hier die größtenteils quantitative Bewertung eine Aggregation der Ergebnisse zu und erlaubt eine intersubjektive Vergleichbarkeit der Daten.

II.3.5 Steuern mit Bordmitteln: Die richtige Tool-Unterstützung

Die Umsetzung der Projektsteuerung erfordert ein Mindestmaß an IT-Unterstützung. Dabei kann beispielsweise auf etablierte Projektmanagement-Tools am Markt zurückgegriffen werden. Alternativ sind selbsterstelle Lösungen denkbar. Erfahrungsgemäß trifft man in der Praxis jedoch oftmals auf eine Kombination aus Standardlösungen und Eigenentwicklungen, was mehrere Ursachen haben kann. Der Markt bietet eine breite Angebotspalette an Standardapplikationen mit unterschiedlichem Funktionsumfang, von spezifischen Anwendungen zur Steuerung von Teilprozessen im Projekt bis hin zu allumfassenden Tools. Da IT-Transformationen jedoch nicht „auf der grünen Wiese" entstehen, sondern Unternehmen in der Regel Applikationen zur IT-Steuerung einsetzen (bspw. SAP im Bereich der Fakturierung und Buchhaltung oder Tools zur Anforderungsanalyse oder zum Fehlermanagement) entsteht die Herausforderung, Standardlösungen möglichst nahtlos in die Applikationslandschaft einzufügen. Häufig ist jedoch mit „IT-Lücken" in der Prozessunterstützung oder Funktionsüberlappungen zu rechnen, die bewertet werden müssen. Zusätzlich entstehen neben Anschaffungs- und Lizenzgebühren meist hohe Aufwände für das Customizing der Software und die Anbindung an bestehende Applikationen, sofern die erforderliche IT-Kompetenz nicht intern verfügbar ist. Nichtsdestotrotz bieten Standardlösungen durch die vorgegebenen Messgrößen und Strukturen vor allem in Unternehmen mit wenig eigenen Erfahrungswerten hinsichtlich der Steuerung von Großprojekten eine gute Anleitung und Orientierung. Eigenentwicklungen bieten hingegen vor allem den Vorteil, dass sie passgenau liefern können, was benötigt ist, und dabei meist flexibler und günstiger in bereits vorhandene Strukturen integriert werden können. Die Folge ist, dass in den meisten Unternehmen eine Mischlösung existiert, die einen unternehmensindividuellen Trade-off darstellt, um die jeweiligen Vorteile von Standardlösungen und Eigenentwicklungen zu nutzen und gleichzeitig die zugehörigen Nachteile zu reduzieren.

Im vorliegenden Beispiel fiel zu Projektbeginn die Entscheidung für eine umfassende Standardsoftware (Microsoft Office Project Server (MOPS)) zur zentralen Projektsteuerung und dem Projektportfoliomanagement der Transformation. Die Investition in eine Standardlösung war dabei rechtfertigbar durch den langen zeitlichen Horizont der Transformation und der damit verbundenen hohen Anzahl an parallel laufenden Projekten und zu steuernden Parameter, was zu der Erwartung führte, dass sich die Einführung der Standardsoftware amortisieren wird. Bereiche wie das Testmanagement (RQM, [IBM 2014]) oder Einkaufsprozesse, z.B. von externen Dienstleistern (Ariba, [ARIBA 2014]) wurden

durch weitere vorhandene Standardlösungen abgedeckt. Daneben fanden sich auch eigenentwickelte Tools wie bspw. Microsoft Office (MS) Excel-Listen zum Tracking von Change Requests (formaler Beschluss, um die Rahmenbedingungen eines Projekts nachträglich an geänderte Anforderungen anzupassen, z.B. durch späte Änderungen in zu erfüllenden gesetzlichen Anforderungen) im Project Management Office. Im letzten Teil des Projekts erfolgte mit Blick auf das nahende Projektende und dem damit einhergehenden „Eindampfen" der temporären großdimensionalen Projekt-strukturen während des Transformationsprojektes, die Ablösung von MOPS durch eine eigenentwickelte Alternative. Die Umsetzung in MS-Excel wurde mit rund 100 Personentagen Aufwand von Mitarbeitern des Project Management Office realisiert. Die Wahl von MS-Excel ist dabei durch mehrere Faktoren begründet: es ist im Unternehmen vorhanden, ausreichend lizensiert, und bietet einen hinreichenden Funktionsumfang, um die Parameter zu steuern. Zudem kann es von vielen Mitarbeitern ohne zusätzliche Anwenderschulungen bedient werden, was auch auf die Entwicklung zutrifft, für die keine weiteren (externen) Experten hinzugezogen werden mussten.

Die Projektsteuerung auf Basis des eigenentwickelten „Excel-Toolkits" enthält drei wesentliche Elemente: eine projektspezifische Excel-Datei je Teilprojekt innerhalb der Releases, eine zentrale Excel-Datei über alle Teilprojekte eines Releases sowie eine zentrale Excel-Datei zur Budgetverwaltung eines Releases (vgl. Abbildung II-3.4).

Projektspezifische Excel-Datei je Einzelprojekt	Zentrale Excel-Datei über alle Einzelprojekte eines Releases	Zentrale Excel-Datei für die Budgetverwaltung
→ Enthält Stammdaten, Projektplanung, -kalkulation, -klassifikation, -status, Meilensteinplanung, Deliverables-Tracker und Zeiterfassung → Detaillierte Planung und Steuerung auf Projektebene	→ Enthält Kern-informationen jedes Projekts: Stammdaten, Projektstatus (inkl. Kernindikatoren zur Steuerung), Projektrisiken → Konsolidierung der projektspezifischen Excel-Dateien	→ Enthält Daten der Budgetverwaltung und Steuerung, z.B. für die Zuweisung phasenspezifischer Budgets, sowie Management von Change Requests, außerdem Reporting → Single Point of Truth bzgl. Budget

Abbildung II-3.4: Übersicht „Excel-Toolkit"

Die projektspezifische Excel-Datei liefert eine detaillierte Planung und Steuerung auf Einzelprojektebene für alle Teilprojekte eines Releases. Stammdaten wie zum Beispiel die Projektidentifikationsnummer oder die Zuordnung zu einem Release wie auch die Projektklassifikation erfolgen zentral über das Projekt Management Office. Auch die beispielsweise durch die Zuordnung zu einem Release vorgegebenen Meilensteine werden

durch das Project Management Office eingespeist. Die Projektleiter ergänzen die Projektplanung und aktualisieren die Daten fortlaufend. So erfolgt auch die Zeiterfassung der Mitarbeiter eines Projekts über die projektspezifische Excel-Datei. Durch Import der jeweiligen Stundenerfassung der Mitarbeiter (Projektressourcen) in die Excel-Datei wird dort der geleistete Aufwand zentral erfasst. Projektressourcen werden vorab vom Projektleiter geplant.

Die projektspezifische Excel-Datei bietet die Möglichkeit, Berichte zum Verfolgen des Budgetverbrauchs und des Fortschritts auf Projektebene zu generieren. Dazu gehören beispielsweise die Möglichkeit den Plan- mit dem Ist-Budgetverbrauch pro Projektressource bis auf Monatsebene darzustellen, oder auch den Projektfortschritt anhand der Meilensteine sowie der nötigen Lieferartefakte, wie z.B. Spezifikationen oder auch sogenannter Software Deliverable Objects (SDO), zu bewerten (vgl. Abbildung II-3.5).

Project Status Report

Basic Data

Release:	2014 - Release 1	Business Area:	Finance	Project End:	31.03.2014	Go-Live:	16.02.2014
Project:	1 14 007 - New GL					
Project Lead Business:	Name Business PL		Project Lead IT:	Name IT PL		
Short Scope Description:	Merger of two general ledgers to a single ledger, thus ensuring streamlined and faster accounting and closing processes. Morevoer, the advantages of New General Ledger are realized, e.g. providing data with different accounting rules in a single ledger using a single integrated Chart of Accounts.					

Overall Status Summary

Time Status:	Green	Scope Status:	Green	Budget Status:	Green	Report Date:	20.01.2014	Report Week:	4

Current	Last	Status Comment	Mitigation Action
Green	Green	GoLive (system change from Classic GL to NewGL) and conversion of source systems to NewGL logic successfully implemented. Retest of open test cases triggered, bug fixing ongoing. Preparation for "Generalprobe": Weekend work approved, systems in preparation, Runbook activities finalized. NewGL trainings scheduled and documentation prepared. Detailed planning for remaining tasks 2014 including GoLive weekend finalized.	Monitor the year end process closely (currently in time).

Detailed Statuses of involved teams (first line: Business team(s), further line(s): IT team(s)

Business Team /	Current	Last	Status Comment	Mitigation Action
Business Status	Green	Green	Go-Live of software successfully executed. Nevertheless, as testing was mainly focussed on Platform 2 and there are still data inconsistencies in downstream applications, it is most likely that Platform 1 will have an intensified post go-live phase!	
IT Plarform 1	Green	Green	Go-Live sucessfully executed.	
IT Platform 2	Green	Green	GoLive of NewGL Platform 2->Platform 3 interface (incl. emergency fixes) successful; no known issues at the moment	
IT Plarform 2	Green	Green	Dry Run Preparation started	
IT Platform 3	Green	Green	Comprehension questions about NewGL-4043 and defects 4030, 4032, 4034. Discussions ongoing	
IT Plarform 3	Yellow	Green	Insufficient Platform Budget allocation to complete ordering systems & Clean ups. New system components needed by 15 Feb	- Clarify budget with project lead - discuss system requirements roadmap.
IT Plarform 4	Green	Green	no known issues	

Budget Overview

EUR (gross)

Budget: 3.421.635 €
Current Estimate: 3.843.561 €
Open Tasks & Actuals: 1.174.697 € / 2.795.842 €

PD

Budget: 3972
Current Estimate: 3151
Open Tasks & Actuals: 497 / 2196

Milestones

Milestone	Baseline Date	Current Date	CE	Open Tasks	Deliverables Total	Open
Milestone - Scope Agreement	01.03.2013	28.02.2013	139	0	4	0
Milestone - End of Spec (v1.0)	12.07.2013	12.07.2013	208	0	8	8
Milestone - End of Realisation	31.10.2013	31.10.2013	1.172	3	3	2
Milestone - End of Testing	16.02.2014	31.03.2014	1.008	423	2	2
Milestone - Go Live	17.02.2014	16.02.2014	0	0	5	5
Milestone - Project End	31.03.2014	31.03.2014	74	74	0	0

Abbildung II-3.5: Excel-Toolkit Auszug aus dem Projektstatusreport eines Einzelprojekts

Alle projektspezifischen Excel-Dateien werden durch das Project Management Office in einer zentralen Excel-Datei konsolidiert. Sämtliche Kerninformationen zu einem Projekt, wie Stammdaten, Projektrisiken und Projektstatus (inklusive der Kernindikatoren zur Steuerung) werden erfasst. Die zentrale Excel-Datei dient vor allem der Aggregation der in den projektspezifischen Excel-Dateien sehr detaillierten Informationen. Ziel ist es dabei, ad hoc

sowie in wöchentlich erstellten „Cockpits" und Berichten, einen konsolidierten Status der Projekte in verschiedensten Aggregationsstufen für das Management bereitzustellen. Die zentrale Excel-Datei ist der erste Anlaufpunkt bei sich abzeichnenden Zielabweichungen, bevor in den projektspezifischen Excel-Dateien nach Ursachen gesucht wird. Sie dient damit neben der Gesamtberichterstattung auf Management Ebene auch für das Controlling im Projekt. Die zentrale Excel-Datei wird ausschließlich von Mitarbeitern des Project Management Office bearbeitet.

Ergänzend findet die zentrale Budgetverwaltung, welche wiederum ausschließlich durch das Project Management Office vorgenommen wird, in einer weiteren Excel-Datei statt. So wird ein „Single Point of Truth" bezüglich der Budgetzahlen sichergestellt. Hauptbestandteil ist die Budgetverwaltung und -steuerung, wie zum Beispiel die Zuweisung phasenspezifischer Budgets, das Management von Change Requests sowie die zugehörige Berichterstattung.

Die vorgestellte Umsetzung einer zentralen Projektsteuerung stellt eine pragmatische Lösung aus der Praxis dar, die auf Basis der drei Bewertungsdimensionen Budgetverbrauch, Projektfortschritt und Projektqualität die erfolgreiche Steuerung einer IT-Transformation unterstützt. Die eingesetzten Steuerungsparameter erfüllen die Anforderungen der Aggregierbarkeit und intersubjektiven Vergleichbarkeit.

II.3.6   Literatur

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III Sustainable Customer Relationship Management in a Digitalized World

The research papers embedded in section III address a sustainable CRM in a digitalized world, focusing on the "enable-perspective" that arises with the opportunities of digitalization. To provide an appropriate multichannel offering and target the right customers within these channels, several aspects have to be considered. First, customer expectations need to be analyzed, second the economic effects of a multichannel offering need to be investigated. Third, when communicating with customers via SM, the most influential users, in terms of customers bringing value to the company, need to be identified.

Research paper 4 *"Just digital or multi-channel? The preferences of e-government service adoption by citizen and business users."* focuses on the preferences of users regarding channel usage for online and offline channels with respect to the services provided. The conducted case study reveals that users ask for a multichannel offering, choosing subjectively suitable channels according to their individual preferences and context of respective services.

Research paper 5 *"Who will lead and who will follow: Identifying Influential Users in Online Social Networks - A Critical Review and Future Research Directions"* focuses on the management of customers in OSN and especially on the identification of the most influential users. It presents an overview of fundamental research on social influence, influential people, and their identification in social networks before the rise of OSN. On that basis, the current state of the art on the identification of influential users in OSN is analyzed and synthesized. Finally, a research agenda is postulated.

III.1 Research Paper 4: "Just Digital or Multi-Channel? The Preferences of E-Government Service Adoption by Citizens and Business Users"

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Abstract:

The digital world has entered governments and public sector institutions. In that context, public e-services have been gaining increasing importance over the last years. However, will everything end up being digital in the future? This article investigates the preferences of citizens and business users to adopt different public services electronically and via further offline channels. Data of 500 citizens and 500 companies were collected together with the German Federal Employment Agency. Our findings indicate that citizens as well as business users ask for a multi-channel offering. They prefer to deliberately choose subjective suitable channels for different services. We furthermore observed a difference between small and medium-to-large companies, such as the latter ones having a stronger preference for online channels than small companies.

Keywords: *E-government, Multi-channel, Case Study Research, German Federal Employment Agency*

III.1.1   Introduction

Since the advent of the Internet, governments and public sector organizations have been harnessing the power of information and communication technology to deliver an increasing number of electronic services [1]. From 2010 to 2012, public e-services grew about 11% worldwide, with the highest level of e-government development in Europe [2]. E-government is mainly concerned with providing value-added information facilitating the information transparency between governments and citizens, and transactional public services electronically to citizens [3-5]. Thus, it has the potential to enhance public sector effectiveness and efficiency, as well as to enable citizens to participate in democratic processes [6]. Recent e-government offerings actually go beyond mere digital information services (e.g., online presence). E-government thereby serves not only to a variety of other actors (e.g., businesses), but also provides more complex services [3], [7-9]. Along with this development, e-government has captured much attention from scholars in recent years.

Prior research has shown particular interest in e-government service adoption especially from a supply side perspective analysing public e-service offerings [3], [4], [8], [10-13]. Also the demand side perspective has been in the focus of recent re-search. However, while there has been quite an effort to investigate citizens in their digital adoption behaviour (e.g., [14-19]), few research has examined the willingness and preferences of business users, i.e. companies, to adopt digital public services [20], [21]. Furthermore, although there is an increasing demand for multi-channel service delivery [2], little research has been done to understand e-government usage in the context of multi-channel. As e-government usage rates currently remain at low level compared to service availability, it is important to better understand the needs of citizens and business users in a multi-channel environment.

This research attempts to fill this twofold research gap by investigating the preferences of citizens and particularly business users to adopt different public services electronically (online) and via further offline channels (in person, by phone, by letter). To get a deep understanding of the phenomenon of interest, we conducted a case study at the German Federal Employment Agency. The German Federal Employment Agency was selected for its strong connection to citizens and firms alike. Furthermore the German Federal Employment Agency is, to the best of our knowledge, one of the only large organisations providing citizens and companies with a multi-channel access to all of their services, thus giving us exclusive access to otherwise inaccessible data. Our research is intended to help public sector institutions and policy makers in their strive to better understand the needs of citizens and in

particular business users regarding which services they prefer via which channel in order to increase satisfaction and trust in governments. We believe that this understanding allows them to define their strategy for a higher service orientation in the context of multi-channel service delivery. It is anticipated that this research will stimulate discussion among the e-government research community, particularly in Germany.

The remainder of this paper is structured as follows: In the next section, we review the existing literature. Section 3 briefly describes the research method including the case setting and the data collection process, while Section 4 presents our findings based on the German Federal Employment Agency case data. After that, we derive managerial and research implications and critically discuss the limitations of our work in Section 5. Finally, we conclude with a brief summary of our research in Section 6.

III.1.2 Theoretical Background

E-government, being understood as a means to electronically deliver government services to citizens and businesses [4], [5], has been in the focus of research for the past decade. Thereby research mostly focuses either on the delivery of services, i.e. the supply side, or on its adoption by citizens or businesses, i.e. the demand side.

III.1.2.1 Research on E-government Service Delivery

E-government is specified as the use of information and communication technology by public administration to create a networked structure for interconnectivity, service delivery, efficiency, effectiveness, transparency, and accountability [22]. It is argued that e-government can be considered either via the type of relationship or the stage of development [7]. Reddick [8], [9] accordingly states that e-government has evolved in two stages. The first stage is the information dissemination phase, i.e. cataloging information online for public use. The second stage is transaction-based e-government, i.e. e-service delivery and transactions being completed online such as paying taxes online. In this paper we will investigate both. As types of government relationships, government to citizen (G2C), government to business (G2B), and government to government (G2G) relationships are considered [8]. The focus of this paper lies on G2C as well as G2B relationships.

Research on the supply side of e-government focuses, for example, on questions regarding how to develop and provide e-services from a government perspective. Topics include, for instance, the development of an appropriate information architecture, factors for successfully implementing information and communication technology, the effective use of the technology

[6], [23-27], as well as related barriers [10], [26]. Ebrahim and Irani [26], for example, construct an integrated architecture framework for e-government that allows aligning IT infrastructure with business process management. Affisco and Soliman [27] present a conceptual framework for selecting and developing e-government applications as part of an overall strategy for e-government service delivery.

Using empirical evidence of actual state and development of e-government in cities, communities, and states, further research examines existing offerings of e-government in order to deduce best practices and to work out effects from comparisons between different levels of public administration (e.g., size and type of government) or countries [3], [4], [8], [10-13]. Moon [10], for example, explores the evolution of e-government at municipal level. He names barriers such as a lack of financial, technical or personal capacities as well as legal issues like privacy as reasons hindering the progress of municipal e-government. He furthermore finds a positive association of the institutional factors size (city size) and type of government (man-ager-council government) regarding the adoption of a municipal website as well as its longevity. Moon and Norris [4] explore the effect of managerial innovativeness in municipal government on the adoption of e-government. They argue that the culture of innovation is an organizational characteristic that needs to be considered besides aspects like size, service demand, and other organizational characteristics already considered in former studies like professionalism, slack resource, and administrative performance.

III.1.2.2   Research on E-government Service Adoption

Research focusing on the adoption of e-government services, i.e. the demand side, often has its foundation in those theoretical frameworks generally exploring the adoption of technology like Roger's [28] diffusion of innovation theory, the technology acceptance model by Davis et al. [29], the theory of reasoned action [30], or the theory of planned behavior [31]. Carter and Bélanger [32], for example, use constructs from the technology acceptance model, the diffusion of innovation theory, and web trust models to form a model of factors influencing citizens' adoption of e-government initiatives. Their empirical findings indicate that perceived ease of use, compatibility and trustworthiness are significant predictors of citizens' intention to use e-government services. Gilbert et al. [14] base their approach on a combination of attitudinal technology adoption models and the service quality concept. Their findings from a survey of UK citizens validate that trust, financial security, information quality (adoption barriers), as well as time and money (adoption benefits) are predicting potential usage of e-government. Based on the technology acceptance model and the theory of planned behavior,

Horst et al. [15] presented a study to identify the role of risk perception and trust on the adoption of e-government services by citizens. Their analysis showed that perceived usefulness of e-services in general determines the intention to use e-government services. Thereby, risk perception, personal experience, perceived behavioral control and subjective norms significantly predict the perceived usefulness of e-services. Also Hung et al. [33] identified factors determining public acceptance of e-government services based on the theory of planned behavior. Shareef et al. [18] aim at discovering critical success factors enabling citizens to adopt e-government at different stages of service maturity. They argue that the technology acceptance model, the diffusion of innovation theory, and the theory of planned behavior cannot capture and specify the complete essence of e-government adoption behavior. They argue that adoption behavior also differs along with different service maturity levels, i.e. different functional characteristics of organizational, technological, economical, and social perspectives. However, with respect to technology adoption models, several studies illustrate that perceived usefulness is an important construct that is able to explain a large percentage of the variance in intention to use e-services [32], [34-36]. Overall, a wide range of individual factors that might explain the adoption of e-government services were considered in several studies, such as perceived risks [37], perceived barriers [14], [38], or trust in e-government [5], [16], [17], [39].

Beyond these individual factors, research found that information and communication adoption barriers, such as access and skill, may vary by culture [16], and that cultural aspects influence e-government service adoption [9], [34], [40], [41]. Furthermore, scholars believe that the need for a sensory experience [19] and the existence of digital divide [42] hinder e-government usage in general. Based on these barriers, further scholars have investigated measures on how to increase e-government adoption. Recent studies, for example, indicate that social media can help to increase e-service adoption in the public sector (e.g., [43]). Moreover, based on a field study, Heidemann et al. [1] found evidence that external marketing to strengthen the awareness of e-services, employee activation and training, as well as improving the technical usability and user-friendliness of e-services can significantly increase usage rates.

While there has been quite an effort to study citizens in their e-service adoption behavior over the last years, few studies have examined the preferences and willing-ness of businesses in adopting e-government services. One of the very few studies is the one of Adeshara et al. [20] examining the readiness of small and medium sized UK companies for accepting e-government services. The authors reveal that there is a moderate demand of these companies

for e-government services. Further, Lee et al. [21] investigate the question why some businesses are more willing to adopt e-government applications for online transactions than others. They found that the businesses' willingness to adopt e-government services depends on the perceived quality of e-services compared to traditional brick and mortar service channels (offline service channels), as well as on the level of trust businesses place in the internet technology itself.

In sum, our brief literature review indicates that most of the existing work either explores e-government services from a supply-side or focuses on analyzing the willingness and influencing factors for e-service demand from a citizens' perspective (G2C), neglecting the G2B perspective. In addition, most studies analyze digital adoption in isolation without considering a multi-channel approach. Therefore, the current study examines the preferences for e-government adoption in the presence of a multi-channel perspective, with a special focus on business users' preferences for e-government services.

III.1.3   Research Method

In this section, we first provide an overview of the case setting of the German Federal Employment Agency. Then we describe the data collection and preparation process that builds the basis of our findings.

III.1.3.1   Case Setting

To investigate the preferences of citizens and business users to adopt public services via different channels (online, in person, by phone, by letter), we conducted a case study. Our selected case organization is the German Federal Employment Agency (Bundesagentur für Arbeit), which is the largest provider of labor market services in Germany with approximately 95,000 employees. The German Federal Employment Agency provides a comprehensive set of services for citizens and companies. Its core tasks include placement in vocational training and employment, career and employer counseling, and providing benefits that substitute for employment income, such as unemployment benefits and insolvency payments. These services are provided through a Germany-wide network of 156 employment agencies and approximately 600 branch offices. The organization was selected for its strong connection to citizens and hundreds of companies (business users). Furthermore it offers most of its services via all four channels (online, in person, by phone, and by letter) so that citizens and business users can choose to adopt the channel they prefer.

The relevant period for our research starts in January 2011, when the German Federal Employment Agency started a campaign promoting its e-services against the background that the online channel becomes more important. Different e-services for citizens and businesses were bundled into the digital job portal JOBBÖRSE (http://jobboerse.arbeitsagentur.de). This portal includes, for example, services for online job seeker registration or services to collaborate with the staff online – for example, to publish applicant profiles, to manage applications, to activate a job search assistant to search for jobs, to respond to placement suggestion, or to communicate with advisors. Similar online services are available to employers (e.g., online registration of workforce demand). Although, in recent years the German Federal Employment Agency steadily developed these e-services further, a clear strategic goal was to have a multi-channel access to all of these services. In that realm, the goal of our case study was to better understand the channel preferences of citizens and business users adopting different e-services. This setup gave us exclusive access to another-wise inaccessible data set.

III.1.3.2 Data Collection

In case study research, "a clear description of data sources and the way they contribute to the research findings is an important aspect of the reliability and validity of the findings" [44, p. 381]. Mainly, our research follows the case study approach by Yin [45]. First, we planned and designed our research. To obtain the necessary data, we followed a two-step approach. In a first step, in close cooperation with the German Federal Employment Agency, in January 2011 we conducted a representative survey of $n = 500$ job seekers respectively unemployed citizens across Germany by tele-phone. We inquired about their channel preferences (online, in person, by phone, by letter) with regard to eleven different services of the German Federal Employment Agency classified along its four categories of services, namely information services (searching for jobs, searching for job information), transaction services (participating in learning courses, managing job applications, receiving job proposals, arranging appointments, contacting employers), service requests (signing on for unemployment benefits, singing on for unemployment), and counseling services (job counseling, unemployment counseling). Each telephone survey took on average 10 minutes to complete. In a second step, our objective was to identify the needs of business users regarding channel preferences. To that end, we surveyed $n = 500$ companies (business users) by telephone. 47.6% were from the service sector, 30.8% from handcraft or trade, 10.8% from industry, 5.8% from the public sector, and the remaining companies were amongst others from agriculture or temporary employment companies. 419 of these companies had less than 100

employees, 81 more than 100 employees. We inquired these companies with regard to their channel preferences for five core services of the Federal Employment Agency along two categories of services, namely transaction services (receiving candidate proposals, registering open job positions, contacting job candidates, and arranging appointments) and service requests (re-questing services for employees, for instance, short-time working benefits). All answers were documented in MS Excel format. The results of the analysis are presented in the following section.

III.1.4 Research Results

This section is dedicated to the research results of our study. First, we focus on the preferences of citizens for adopting e-government services. The second part concentrates on the preferences of business users of small and medium-to-large companies.

III.1.4.1 Citizen's Preferences

To investigate the preferences of citizens to adopt public services via online and offline channels, we compare different core services of the German Federal Employment Agency. The eleven services considered range from arranging appointments, over searching for jobs to job counseling. For each of the services we calculated which share of the 500 surveyed citizens indicated an adoption preference for each of the provided four channels (online, in person, by phone, by letter). Figure III-1.1 illustrates the results.

First and foremost, the survey results reveal that citizens prefer having multiple service channels rather than preferring the online channel for everything. This holds true in two ways: First, for different services different channels are primarily preferred. For instance, when searching for jobs, citizens primarily prefer to use the online channel, when arranging appointments the majority of the surveyed citizens prefers the telephone channel and for job and unemployment counseling, citizens predominantly prefer to interact with the German Federal Employment Agency in person. Second, also within each service, different citizens prefer different channels. For instance, for managing job applications citizens have mixed preferences between online (34% of the surveyed citizens with adoption preferences), in person (40%), by phone (5%), and by letter (21%).

When we analyze the citizens' adoption preferences in more detail, we find digital adoption preferences across all services and service categories. However, these adoption preferences vary substantially, ranging from 2% (for unemployment counseling) to 43% (for participating in learning courses as well as searching for jobs). In fact, the online channel is preferred most for information services (searching for job information, searching for jobs) and transaction

services (participating in learning courses, managing job applications, receiving job proposals, arranging appointments, contacting employers): For instance, 43% of the surveyed citizens prefer the online channel for searching for jobs and participating in learning courses, 34% prefer it for managing job applications. For administrative (transaction) services like arranging appointments and contacting employers there is a lower digital adoption preference with 15% respectively 12% than for the other transaction services. For these services, telephone is the preferred channel: 66% of all citizens prefer to arrange appointments and 39% prefer to contact employers by phone.

For service requests online adoption preferences account for solely 10% (signing on for unemployment) respectively 14% (signing on for unemployment benefits), indicating just a minor interest in digital services. In fact, for service requests and counseling services citizens rather prefer to interact with the German Federal Employment Agency in person: For instance, 93% of citizens prefer unemployment counseling and 74% prefer signing on for unemployment in person. Overall, today, across all services, most citizens prefer to interact with the German Federal Employment Agency in person.
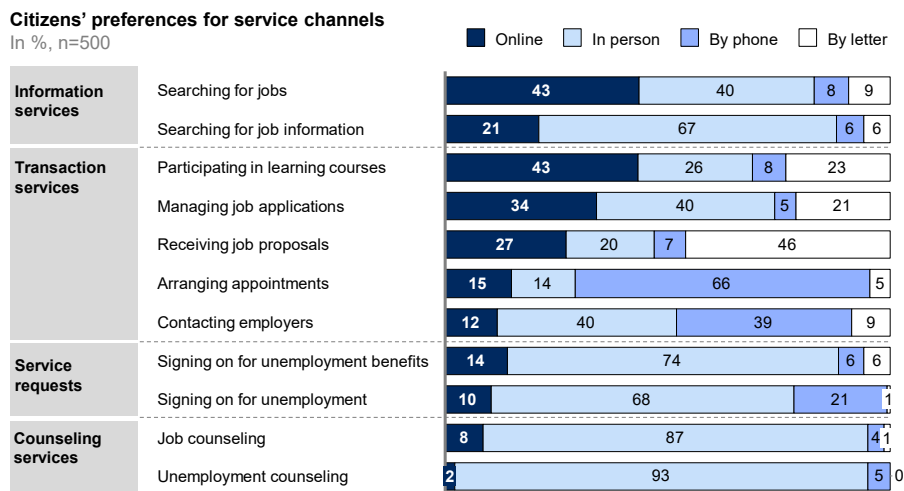
Citizens' preferences for service channels
In %, n=500

Legend: Online | In person | By phone | By letter

Category	Service	Online	In person	By phone	By letter
Information services	Searching for jobs	43	40	8	9
	Searching for job information	21	67	6	6
Transaction services	Participating in learning courses	43	26	8	23
	Managing job applications	34	40	5	21
	Receiving job proposals	27	20	7	46
	Arranging appointments	15	14	66	5
	Contacting employers	12	40	39	9
Service requests	Signing on for unemployment benefits	14	74	6	6
	Signing on for unemployment	10	68	21	1
Counseling services	Job counseling	8	87	4	1
	Unemployment counseling	2	93	5	0

Fig. III-1.1 Citizens' preferences for service channels

It could be argued that the preference for multi-channel as well as the rather low digital adoption preferences for some services can be explained by the citizens' rejection of online services in general. However, also citizens using the internet daily for other services, in total 215 citizens, prefer multi-channel: Still, for information and transaction services the online channel is preferred substantially, for service requests and counseling services citizens prefer interactions in person. The channel preferences are just slightly shifted towards online for those citizens using the internet daily. For instance, 74% (instead of 43% of all citizens) prefer to search for jobs online, and 64% (instead of 43%) indicate to prefer participating in learning

courses online. Also dissatisfaction with the online services of the Federal Employment Agency cannot be seen as a conclusive explanation for low digital adoption preferences. In fact, almost two third of the surveyed citizens assess the online services of the Federal Employment Agency as very or entirely understandable (68%), visually appealing (67%), easy to find (67%), and easy to operate (64%).

Thus, to sum up, all our results indicate that citizens deliberately ask for a multi-channel offering, preferring subjective suitable channels for different services rather than preferring the online channel for any service.

III.1.4.2 Business Users' Preferences

For the 500 business users we surveyed, we compare channel preferences between five different services from receiving candidate proposals to requesting services for employees.

Thereby, our results reveal an overall preference for multi-channel. In fact, for different services, business users have different channel adoption preferences. This holds true for all services in both service categories examined. For instance, for requesting services for employees, 10% of business users prefer online, 25% an interaction in person, 51% by phone and 14% by letter (cf. Figure III-1.2).
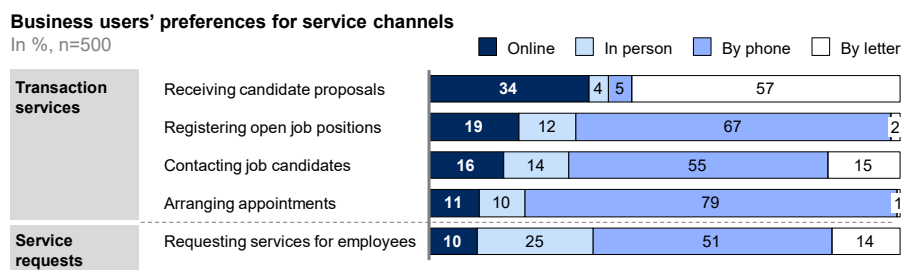

Fig. III-1.2. Business' preferences for service channels

Analyzing business users' adoption preferences in more detail, we find digital preferences across all services, however varying substantially. Online preferences range from 10% for requesting services for employees (for instance for requesting short-time working benefits for employees) to 34% for receiving candidate proposals. Our results reveal that the online channel is preferred more for transaction services (receiving candidate proposals, registering open job positions, contacting job candidates, arranging appointments) than for service requests (requesting services for employees): For instance, for receiving candidate proposals 34% of the surveyed business users indicate online preferences, for registering open job positions at least 19% do, while for service requests the digital adoption preference accounts solely for 10% (requesting services for employees). Within transaction services,

administrative services like contacting job candidates and arranging appointments have a lower online adoption preference with 16% respectively 11% than the other transaction services.

Overall, across all services (except receiving candidate proposals), business users strongly prefer the interaction by phone (ranging from 51% to 79%). For receiving candidate proposals, by letter is the preferred channel with 57%. The least preferred channel, when taking an average across all services, is the interaction with the German Federal Employment Agency in person.

Note that the moderate digital adoption preferences cannot be explained by a rejection of the Federal Employment Agency's online services in general. Also business users already using its online services (in total 159 business users) prefer multi-channel. Their online adoption preference is just slightly higher for all services: For instance, 43% of them (instead of 34% of all business users) prefer receiving candidate proposals online. Moreover, business users are satisfied with the digital services of the Federal Employment Agency with more than two thirds of the surveyed companies assessing the online presence of the German Federal Employment Agency to be understandable (73%), visually appealing (71%), easy to find, and easy to operate (69%).

Thus, similar to our results on citizens, we see a strong preference of business users for a multi-channel offering rather than an online preference for any service. Both business users and citizens deliberately choose subjective suitable channels for different services.

In addition to business users in general, we analyzed differences in the digital adoption preferences between small companies (<100 employees) and medium-to-large companies (>100 employees). Thereby, our results reveal that across all services, medium-to-large companies have a stronger preference for online services than small companies. For registering open job positions and arranging appointments the preference for the online channel is almost three times as high for medium-to-large companies (42% respectively 23%) than for small companies (15% respectively 8%). However, also for medium-to-large companies, online is just one channel amongst others. At most, 42% of the surveyed business users prefer the online channel for one service (registering open job positions). Figure III-1.3 illustrates the results.
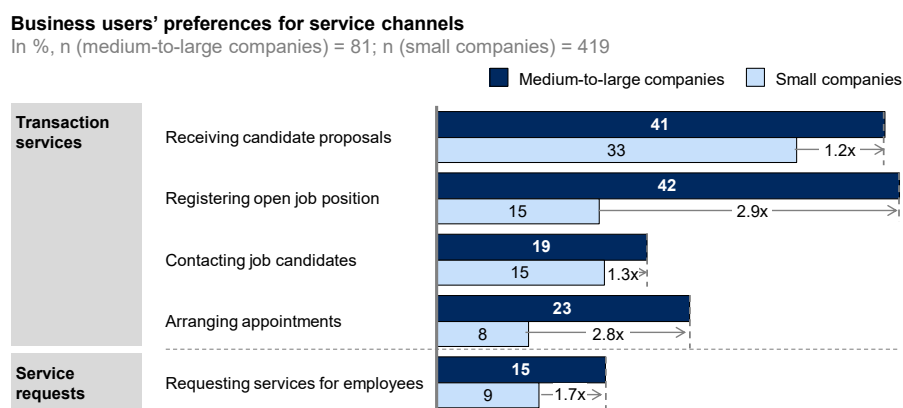
Business users' preferences for service channels
In %, n (medium-to-large companies) = 81; n (small companies) = 419

■ Medium-to-large companies ☐ Small companies

Transaction services	Receiving candidate proposals	41 / 33 → 1.2x
	Registering open job position	42 / 15 → 2.9x
	Contacting job candidates	19 / 15 → 1.3x
	Arranging appointments	23 / 8 → 2.8x
Service requests	Requesting services for employees	15 / 9 → 1.7x

Fig. III-1.3. Business' preferences for service channels segmented by company size

III.1.5   Discussion, Limitations, and Future Research

In this section we critically discuss the results of our survey, point out limitations and respective topics for future research.

III.1.5.1   Discussion of the Results

Our results reveal that both citizens and business users prefer multi-channel when interacting with public sector organizations like the German Federal Employment Agency. Citizens thereby prefer the online channel predominantly for those services, they see distinctive advantages (adoption benefits) of digital action for (cf., [14], [16]). In particular, this holds true for most information services (e.g., searching for jobs (43% adoption preferences)) and transaction services (e.g., participating in learning courses (43%), managing job applications (34%), and receiving job proposals (27%)); i.e. for services citizens want to gather and receive information or data with-out need for further discussion. In contrast, when citizens need individualized advice, as it is the case for counseling services (e.g., job counseling, unemployment counseling) and service requests (e.g., signing on for unemployment benefits, signing on for unemployment), they prefer to interact with the German Federal Employment Agency in person (cf., job counseling (87% adoption preferences) and unemployment counseling (93%)). These findings are in line with former studies identifying that the perceived usefulness of e-services determines the intention to use these services [15], [32], [34-36]. Thereby, for some services like counseling services, for instance, trust is assumed to affect the perceived usefulness and thus the choice of the service channel.

For G2B relationships we made similar observations as for G2C relationships. Business users also show a strong preference for a multi-channel offering rather than an online preference for any service (cf., [20]). Nevertheless, we find online preference across all services, however

varying substantially from 10% for requesting services for employees (service request) to 34% for receiving candidate proposals (transaction service). In contrast to citizens, who generally prefer contact in person, business users strongly prefer contact by phone for almost all services (cf., registering open job positions (66%) and requesting services for employees (51%)).

In addition to our findings on business users in general, we found differences regarding the adoption behavior of small and medium-to-large companies. In fact, the preference for online services is larger for medium-to-large companies than for small ones. This might be explained by the fact that the frequency of interaction increases with company size (scaling effects). Furthermore, smaller companies might operate more "hands on", preferring "pragmatic solutions" like contacting the German Federal Employment Agency by phone.

To sum up, our results reveal that it is important for public sector organizations to offer and further develop online services. However, online services should be seen as supplements to existing offline services. Moreover, different channel strategies for distinct services and user groups should be defined. Particularly information and transaction services, for which users already predominantly prefer the online channel and have low adoption barriers, should be digitalized. In contrast, multi-channel solutions should be provided for service requests and counseling services, for which users have divergent preferences. In particular for counseling services with citizens seeking individualized advice, an interaction in person will remain of great importance further on. At the same time however, public sector organizations have to continue improving their online offerings in order to reduce prejudices of users and further promoting online solutions. This particularly holds true for service requests like signing on for unemployment benefits or signing on for unemployment, for which users might overestimate the complexity of the processes and consequently prefer offline channels until now.

III.1.5.2 Limitations and Future Research

Despite the contributions of this article, our results have to be seen in the light of some limitations. First, we only conducted a single case study in one country. However, the case allowed us to gain deep insights into a natural setting [44]. In addition, the German Federal Employment Agency is one of the largest public sector institutions in Europe. Thus, we can assume that our results have certain significance. Nevertheless, future research should consider further cases, for example, in other (European) countries, to validate our results or find evidence such as for cultural differences regarding e-government adoption preferences (cf., [16]). Second, we did not classify the surveyed citizens, for example, according to demographic aspects. However, when developing a multi-channel strategy for governments it

might be helpful to know and understand typical user groups in order to better customize offerings. The same holds true for the business context. Further classifying business users, for instance, according to their respective industries, might help to develop proper multi-channel strategies. Finally, future research should also evaluate multi-channel offerings considering economic effects. Although our survey indicates that users prefer to choose suitable channels themselves, when developing a multi-channel strategy it might not be reasonable, from an economic point of view, to provide all channels for all services. Thus future research should evaluate implementation strategies and consequences for different categories of services, like information, transaction, or counseling services.

III.1.6   Conclusion

Will everything end up being digital in the future? With e-government as a means to electronically deliver government services to citizens and businesses, the digital world has entered governments and public sector institutions. In this case study we investigated the preferences of citizens and business users for adopting different public services such as information, transaction, counseling services, and service requests online and via offline channels (i.e., in person, by phone, and by letter). We conducted representative surveys of n = 500 unemployed citizens and n = 500 companies from different sectors across Germany, inquiring about their channel preferences with regards to different services of the German Federal Employment Agency.

Our findings indicate for both citizens and business users preferences for a multi-channel offering, thus an offering that provides users the option to consciously choose a subjective suitable channel for services by themselves. Citizens and business users thereby prefer the online channel predominantly for information and transaction services. In addition, for G2B relationships we observed a difference in the digital adoption preferences between small and medium-to-large companies. Latter have a stronger preference for online services than small companies, which presumably can be explained by scaling effects.

Thus, both from a citizen and business user perspective, online services should be seen as supplements rather than substitutes. A mere replacement of offline services through online services without creating a distinct advantage of the online channel is not sufficient and expedient. To build up a proper multi-channel offering, public sector organizations need to identify different channel strategies for distinct services and user groups. Service offerings should particularly digitalize in information and transaction services for which users already predominantly prefer the online channel and have low adoption barriers. In contrast, multi-

channel solutions should be provided for more sophisticated services. At the same time, public sector organizations need to continuously improve their online offerings and further promote online solutions for services that are until now overestimated in their complexity by citizens and business users.

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III.2 Research Paper 5: "Who will lead and who will follow[1]: Identifying Influential Users in Online Social Networks – A Critical Review and Future Research Directions"

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Abstract:

Along with the explosive growth of the phenomenon Online Social Networks (OSN), identifying influential users in OSN received a great deal of attention in recent years. However, the development of practical approaches for the identification of influential users is still in its infancy and researchers face numerous challenges. By means of a structured literature review, we analyze and synthesize the growing number of publications particularly from two perspectives. From a research perspective, we find that existing approaches mostly build on users' connectivity and activity but hardly consider further characteristics of influential users. Moreover, we outline two major research streams. It becomes apparent that most marketing-oriented articles draw on real-world datasets of OSN, while rather technical-oriented papers have a more theoretical approach and mostly evaluate their artifacts by formal proofs. We find that an even stronger collaboration between the scientific Business & Information Systems Engineering (BISE) and Marketing community than observed today could be mutually beneficial. With respect to a practitioner's perspective, we compile advice

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[1]   Adopted from Katz (1957, p. 73).

on the practical application of approaches for the identification of influential users. It is hoped that the results can stimulate and guide future research.

Outline:

One of the most important questions at the heart of viral marketing is how companies can identify and target the "right" initial set of influential users in Online Social Networks (OSN). Even though we find that both the scientific Business & Information Systems Engineering (BISE) and Marketing community engage in research on the identification of influential users in OSN, the development of practical approaches is still in its infancy. Therefore, we analyze and synthesize the growing number of scientific publications and hope that the results can stimulate and guide future research.

Keywords: *viral marketing, information diffusion, word-of-mouth, influence, contagion, influentials, literature review, online social networks*

III.2.1 Introduction

For decades, marketers have been intensively investigating the effects driving the diffusion and adoption of new products and services. In this context, major developments could be observed over the last couple of years: First, the impact of traditional marketing techniques has been constantly decreasing (Clemons 2009, p. 48 f.; Hinz et al. 2011, p. 55; Trusov et al. 2009, p. 90). Second, consumers increasingly trust in recommendations of other consumers, acquaintances, and friends (Chen and Xie 2008; Iyengar et al. 2011b; Narayan et al. 2011; Schmitt et al. 2011). Third, it recently has become widely accepted that social influence actually affects the diffusion process and that there are influential people who have disproportionate influence on others (Godes and Mayzlin 2009; Goldenberg et al. 2009; Hinz et al. 2013; Iyengar et al. 2011a). Such social influence can be defined as "[…] change in the belief, attitude, or behavior of a person […], which results from the action, or presence, of another person […]" (Erchul and Raven 1997, p. 138), usually denoted as influencer. To respond to these developments and to leverage the effect of social influence on product adoption, companies increasingly try to actively initiate and control the diffusion process by targeting the most influential people in a social network (Bonchi et al. 2011, p. 21; Hinz et al. 2011, p. 55; Libai et al. 2010, p. 271). Thus, with small marketing costs a very large part of the network should be reached. However, among others, one key prerequisite needs to be fulfilled: Companies need to be able to identify and target the "right" initial set of influential people (Iyengar et al. 2011b, p. 195; Hinz et al. 2011, p. 55 f.).

Traditionally, self-designation, that is, people report their own influence in surveys (cf. Rogers and Cartano 1962), has been popular to identify influential people. More sophisticated socio-metric techniques, that is, using network data on social connections, could only scarcely be used at a larger scale, as datasets have often been too small (Corey 1971, p. 52; Watts 2004, p. 5). However, due to the rise of modern communication networks and the Internet, the usage of network data for the identification of influential people gained increasing popularity in research and practice (cf. e.g., Bampo et al. 2008; Hill et al. 2006; Hinz et al. 2011; Nitzan and Libai 2011). Especially along with the explosive growth of the phenomenon of Online Social Networks (OSN) to currently more than one billion active users and 140 billion friendship connections as of October 2012 solely on Facebook (Facebook 2012), identifying influential users in OSN is receiving a great deal of attention in recent years (Bonchi et al. 2011, p. 21; Hinz et al. 2013; Katona et al. 2011, p. 426). Besides mere social connections, which for instance could be observed in telecommunication networks as well, OSN allow for analyzing the diffusion process taking into account additional information such as detailed

demographic data, personal interests, the level of activity with respect to different technical features of OSN (e.g., comments, likes), and partly even the content and sentiment of communication (e.g., in public wallposts). Moreover, users thereby usually reveal more information than in an offline context, as online communications tend to be more uninhibited, creative, and blunt (Wellman et al. 1996, p. 213). Thus, OSN provide a unique and vast amount of user data (also referred to as "digital trace data", cf. Howison et al. 2011) that was not available before and can now be leveraged for marketing purposes[2] (Bonchi et al. 2011, p. 2; Katona et al. 2011, p. 425 f.; Subramani and Rajagopalan 2003, p. 301).

However, the development of practical approaches for the identification of influential users in OSN is still in its infancy (Richter et al. 2011, p. 98) and researchers face numerous challenges: First, the processing of previously unknown large amounts of (digital trace) data and the consequently required scalability of existing approaches for the identification of influential people are not trivial (cf. e.g., Watts 2004). Second, research based on such data faces numerous validity issues (cf. Howison et al. 2011) and several sources of bias might confound the identification of influential users in OSN (cf. section 2.1). Third, findings from research on viral marketing and the identification of influential people in an offline environment or from the "old Internet" may not be transferred to the context of OSN without critical reflection (cf. e.g., Brown et al. 2007; Eccleston and Griseri 2008, p. 608; Howison et al. 2011, p. 768; Susarla et al. 2012). Therefore, further research is needed in order to overcome these challenges and to achieve a better understanding in research and practice.

What can a critical literature review contribute? We believe that the growing number of publications on the identification of influential users in OSN needs to be analyzed and synthesized to assess the applied methods, knowledge, and theories (Scandura and Williams 2000) as well as to identify research gaps that can be addressed in future research (Webster and Watson 2002). For our following analysis, we define OSN as "[…] web-based services that allow individuals to (1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system" (Boyd and Ellison 2007, p. 211) but focus on user-oriented sites (Pallis et al. 2011, p. 220), "[…] where, to a certain extent, networking is the main preoccupation" (Beer 2008, p. 518). In contrast, content-oriented sites such as Twitter, YouTube, or Flickr exhibit some features of OSN but are rather

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[2]   For a critical discussion of related fundamental problems such as the access to data from OSN, privacy issues, and validity concerns see for instance Howison et al. (2011), Lazer et al. (2009) and with respect to the identification of influential users in OSN section 5.

microblogging sites or content communities with different characteristics than OSN (Heidemann et al. 2012, p. 3867; Pallis et al. 2011, p. 220; Richter et al. 2011, p. 90; Smith et al. 2012, p. 103). For instance, Wu et al. (2011, p. 707) found that Twitter "[…] does not conform to the usual characteristics of social networks, which exhibit much higher reciprocity […] [Kossinets and Watts 2006]". Prior research also emphasizes that on content-oriented sites "[…] the primary motivation and goal of the majority of users is the content instead of socialization" (Laine et al. 2011, p. 2). Some content-oriented sites are therefore even perceived as a "[…] mixture of one-way mass communications and reciprocated interpersonal communications" (Wu et al. 2011, p. 707). Consequently, (partly) different data can be collected in OSN and content-oriented sites (e.g., friendship connections in Facebook versus followers in Twitter). Treating them interchangeably might raise several validity issues along the chain of reasoning when drawing conclusions on a construct under consideration (e.g., social influence) based on data from these information systems (i.e., a content-oriented site or an OSN) (cf. Howison et al. 2011, p. 772). For instance, theoretical cohesion might not be given when operationalizing constructs deduced from theories on (offline) social networks with data from content-oriented sites. Before in further research the focus could be on the identification of influential users in content-oriented sites and commonalities and differences to their identification in OSN, this paper aims at laying the foundations by concentrating on OSN as the currently predominant phenomenon. Thereby, two particular perspectives should be informed (cf. Poeppelbuss et al. 2011, p. 506): a research perspective that relates to the theoretical and methodological aspects and a practitioner's perspective that covers issues relevant to users of approaches for the identification of influential users in OSN.

The remainder of this paper is organized as follows: In the next section, we provide an overview on important foundations from the context of social influence as well as the identification of influential people in social networks and delineate three research questions: (1) How are influential users characterized in the context of OSN? (2) Which approaches have been developed and applied for the identification of influential users in OSN? (3) How have these approaches been evaluated and which implications have been derived? In section 3, we outline the procedure of our structured literature search. In the subsequent section 4, we present our findings regarding the three research questions and critically discuss the identified articles from a research perspective. By highlighting nine implications of our literature review, we point out future research directions in section 5. Thereby, also an audience from practice, who adopt approaches for the identification of influential users, can benefit. Finally, in section 6 we draw an overall conclusion and explicate limitations.

III.2.2 Foundations and Research Questions

As previously mentioned, marketers aim at targeting the most influential people in social networks in order to initiate a diffusion process that allows for reaching a large part of a network with small marketing cost (Bonchi et al. 2011, p. 21). To do so, three key assumptions need to be fulfilled (Iyengar et al. 2011b, p. 195): (1) social influence needs to be at work, (2) there actually need to be influential people in the social network who have disproportionate influence on others, and (3) companies need to be able to identify and target these influential people. With respect to these three assumptions, we briefly review relevant literature from economics, marketing, and sociology beyond the context of OSN that constitutes the foundation for research on the identification of influential users in OSN. Thereby, we also derive our re-search questions that are addressed in the subsequent structured literature review.

III.2.2.1 *Social Influence in the diffusion process*

After Moreno (1934) coined the term "sociometry" when formalizing social relationships, Rapoport (cf. e.g., Rapoport 1952; 1953; Rapoport and Rebhun 1952) was one of the first who applied "[…] sociometric ideas to large-scale social systems […]" and "[…] elaborated on the formal implications […]" in the context of predictive epidemiological models of contagion (Scott 2000, p. 15 f.). Similar ideas have been used to understand the diffusion of innovations (cf. e.g., Rogers 1962), such as technical innovations in an agricultural context (Beal and Bohlen 1955; 1957; Ryan and Gross 1943), or new drugs in physicians' networks (Coleman et al. 1966). While these studies implied that diffusion was driven by communication (cf. also Valente 1995; Valente and Rogers 1995), others found contradicting results showing that diffusion was rather a result of imitation (Mansfield 1961) or comparison (Burt 1987). Strang and Tuma (1993) even found traces for both, communication and comparison effects. In the field of marketing, Arndt (1967) studied product-related word-of-mouth with respect to the diffusion of information, which led to ground-breaking product growth models (cf. e.g., Bass 1969; Mahajan and Muller 1979). Hereby, diffusion has traditionally been perceived again only as theory of interpersonal communication (Peres et al. 2010, p. 92). Besides this interpersonal communication, some more recent studies suggest incorporating additional potential sources of influence on the diffusion process (e.g., Goldenberg et al. 2010; Van den Bulte and Lilien 2001). Peres et al. (2010, p. 92) consequently state that influence should "[…] include all of the interdependencies among consumers that affect various market players with or without their explicit knowledge". In this context, it generally needs to be distinguished

between social influence and heterogeneity as driving forces of diffusion (Peres et al. 2010, p. 92 f.; Van den Bulte and Stremersch 2004).

In line with French and Raven (1959), who developed one of the most recognized frameworks in the area of social and interpersonal power (Mintzberg 1983), social influence can be defined as "[…] change in the belief, attitude, or behavior of a person […], which results from the action, or presence, of another person […]" (Erchul and Raven 1997, p. 138). Such social influence can be induced by all kinds of consumer interactions like traditional one-to-one word-of-mouth, the observation of others, or one-to-many communication as in the case of OSN (Godes et al. 2005, p. 416; Nitzan and Libai 2011, p. 25). In literature, the process of social influence is also often referred to as social contagion (e.g., Hinz et al. 2013; Iyengar et al. 2011b; Van den Bulte and Stremersch 2004). Van den Bulte and Wuyts (2007) distinguish five reasons for social contagion (cf. also Van den Bulte and Lilien 2001), with the first two being especially relevant for viral marketing (Hinz et al. 2011, p. 59). First, awareness and interest for a product or innovation might be induced by information transferred for instance by word-of-mouth (cf. e.g., Katz and Lazarsfeld 1955). Second, social learning about benefits, costs, and risks of products, services, or innovations might allow reducing search efforts and uncertainty (cf. e.g., Iyengar et al. 2011a). Third, normative pressures might lead to discomfort when not adopting a new product or innovation, that is, people feel the need to conform to the expectations of their peer group as they wish to fit in (cf. e.g., Asch 1951; Deutsch and Gerard 1955). Fourth, not adopting a product or innovation might even lead to status or competitive disadvantages. In literature, the first three reasons are also referred to as cohesion and the fourth as structural equivalence (Burt 1987). In this context, a recent study by Hinz et al. (2013) indicate that structural equivalence drives adoption more than cohesion. Fifth, network externalities might drive social contagion due to an increasing utility that originates from the consumption of a good when the number of other people consuming this good grows (cf. e.g., Granovetter 1978; Katz and Shapiro 1994).

In contrast, research under the heterogeneity hypotheses claims that diffusion rather depends on heterogeneous consumer characteristics such as innovativeness, price sensitivity, or needs that influence the probability and time of adoption (Peres et al. 2010, p. 92). Since common diffusion models (e.g., Bass 1969) often assume a fully connected and homogenous social network or omit marketing efforts (e.g., Coleman et al. 1966), doubts have been rising whether social influence has been overestimated (Van den Bulte and Lilien 2001; Van den Bulte and Stremersch 2004). Further studies show that the role of social influence may also have been confounded due to several potential sources of bias (cf. e.g., Aral and Walker 2012; Garg et

al. 2011; Hartmann et al. 2008), such as simultaneity (i.e., the tendency for connected users to be exposed to the same external stimuli) (Godes and Mayzlin 2004), homophily and endogenous group formation (i.e., the tendency to choose friends and to form social groups with similar tastes and preferences) (Aral et al. 2009; Hartmann 2008; McPherson et al. 2001; Nair et al. 2010), or other contextual and correlated effects (Manski 1993; Manski 2000; Moffitt 2001). Therefore, recent studies have been controlling for heterogeneity and other potential sources of bias (cf. e.g., Garg et al. 2011; Hinz et al. 2013; Nair et al. 2010; Susarla et al. 2012), for instance by conducting large-scale randomized experiments in real-world settings (cf. e.g., Aral and Walker 2012). Other studies have been decomposing the adoption process in its different phases (e.g., awareness and evaluation phase, adoption phase) while incorporating marketing efforts (Manchanda et al. 2008; Van den Bulte and Lilien 2003). Taken together, even though also heterogeneity and several other factors play an important role in the diffusion process, the presence of social influence could be confirmed and is generally acknowledged today (Iyengar et al. 2011a).

III.2.2.2   Characterization of Influential People in Social Networks

Already since Katz and Lazarsfeld (1955) started the discussion about the "flow of mass communications", it is agreed upon the fact that some people are more influential than others (cf. e.g., Godes and Mayzlin 2009; Goldenberg et. al. 2009; Iyengar et al. 2011a). Their original definition of influential people as "[…] individuals who were likely to influence other persons in their immediate environment" (Katz and Lazarsfeld 1955, p. 3) with respect to their opinions and decisions remained more or less unchanged until today (Watts and Dodds 2007, p. 442). A central question in this context is how these influential people can be characterized. Katz (1957) states that the ability to influence is related to three (personal and social) factors (cf. Weimann 1991, p. 2): (1) the personification of certain values ("who one is"), (2) the competence ("what one knows"), and (3) the strategic social location ("whom one knows"). This categorization finds also affirmation in the works of Gladwell (2000) and Watts and Dodds (2007). The first factor alludes to distinct characteristics, that is, abilities which make a person persuasive. For instance, usually salesmen have these charismatic traits and communication abilities to successfully convince people (Gladwell 2000, p. 70; Eccleston and Griseri 2008, p. 595). Watts and Dodds (2007, p. 442) characterize such people to be respected by others. The second factor relates to mavens, that is, highly informed individuals (Watts and Dodds 2007, p. 442) or even experts in distinct fields of knowledge (Gladwell 2000; Eccleston and Griseri 2008). Mavens might be especially influential in the case of cohesion driven by information transfer and social learning (cf. e.g., Iyengar et al. 2011a), whereby it is important

to bear in mind that peoples' influence might be contextual sensitive. The last factor describes the position of an individual within a society. It specifically refers to connectors, characterized as "[…] people with a special gift for bringing the world together" (Gladwell 2000, p. 38). Such people are usually well-connected (Watts and Dodds 2007, p. 442) and enjoy meeting new people as well as introducing them to others they know (Eccleston and Griseri 2008, p. 594). Thus, people with a high degree of connectedness have the opportunity to influence the behavior of others (Barabási 2003; Van den Bulte and Wuyts 2007). Van den Bulte and Stremersch (2004) point out that such well-connected people might be particularly influential when cohesion (cf. section 2.1.) is at work. In case of competition for status, however, this might not be the case (Burt 1987). Furthermore, tie strength, that is, the intensity of the connections, moderate the impact of social influence (cf. e.g., Brown and Reingen 1987; Burt 1992; Granovetter 1973).

By means of these three – not mutually exclusive – factors, Katz (1957) provided a classification scheme of how influential people can be characterized in general. With the provided context at hand, we first examine how influential people are characterized in literature on the identification of influential users in OSN:

Q.1   How are influential users characterized in the context of OSN?

III.2.2.3   Identification of Influential People in Social Networks

Multiple studies investigating the question whether and to what extent people might be influential focused primarily on the strategic location within a social network based on its structural characteristics (cf. e.g., Borgatti 2006, p. 21; Bampo et al. 2008; Kiss and Bichler 2008) (cf. third factor that characterizes influential people, section 2.2). Structural characteristics are thereby defined as patterns of connections among actors in a social network (cf. Oinas-Kukkonen et al. 2010). The structure resulting from connections among people is mostly described as a set of nodes and directed or undirected edges that connect pairs of nodes. These nodes and edges determining the network structure can be represented by a graph (Watts 2004; Wasserman and Faust 1994).

Several approaches for the identification of important nodes in such a graph can be found in social network analysis (SNA) (for an overview of SNA in the context of marketing cf. e.g., Iacobucci 1996). For instance, several measures exist that indicate the social influence of nodes on other nodes in a network (Friedkin 1991). The three most common measures to quantify the centrality of a certain node in social networks are presented in Freeman's article "Centrality in Social Networks: Conceptual Clarification" (Freeman 1979): Degree centrality,

closeness centrality, and betweenness centrality (for a critical review with respect to a marketing context cf. e.g., Kiss and Bichler 2008; Landherr et al. 2010). The first centrality measure called degree centrality represents the simplest instantiation of centrality, assuming that a node with many direct connections to other nodes is central to the network. Such well-connected nodes are often called "hubs" (Bampo et al. 2008). As Hinz et al. (2011, p. 57 ff.) point out, some studies suggest that these hubs should be considered as influential people (cf. e.g., Iyengar et al. 2011b; Kiss and Bichler 2008; Van den Bulte and Joshi 2007). However, other studies found that "fringes", that is, poorly connected nodes characterized by low degree centrality might be particularly influential (cf. e.g., Galeotti and Goyal 2009; Sundararajan 2006). The second measure named closeness centrality expands the definition of degree centrality by focusing on how close a node is to all other nodes in the network. The idea behind the third measure referred to as betweenness centrality is that if a node is more often on the shortest paths between other nodes, it is more central to the network. Prior work also indicates that such "bridges" connecting otherwise unconnected parts of a network should be considered as influential people (cf. e.g., Rayport 1996; Hinz and Spann 2008). A further popular centrality measure, namely eigenvector centrality, is proposed by Bonacich (1972). Since a node's connectivity in the whole network is incorporated (Bolland 1988), approaches based on the eigenvector try to find well-connected nodes in terms of the global or overall structure of the network, and pay less attention to local patterns (Hanneman and Riddle 2005). Connections to nodes that are themselves influential are therefore assumed to lend a node more influence than connections to less influential nodes (Newman 2003). Thus, eigenvector centrality and related measures such as PageRank deviate from degree, closeness, and betweenness centrality by modeling inherited or transferred status (Liu et al. 2005) that also allows for modeling network effects in the context of viral marketing (cf. e.g., Richardson and Domingos 2002). Taken together, it can be stated that despite the extensive usage of these well-established centrality measures, "[…] little consensus exists regarding recommendations for optimal seeding strategies" (Hinz et al. 2011, p. 58).

The second research stream on the identification of influential people goes back to Domingos and Richardson (2001), who studied the so-called "influence maximization problem". This refers to the combinatorial optimization problem of identifying the target set of influential people (also often referred to as "top-k nodes") that allows for maximizing the information cascade in the context of viral marketing (cf. also Richardson and Domingos 2002). By applying three approximation algorithms to their NP-hard problem, Domingos and Richardson (2001) were able to prove that the selection of the "right" target set can make a

substantial difference for a marketing campaign. Based on these works, Kempe et al. (2003) investigated two of the "[…] most basic and widely-studied diffusion models" (Kempe et al. 2003, p. 138), that is, the linear threshold (LN) and the independent cascade (IC) model. Both models are so-called susceptible/infectious/recovered (SIR) models that do not allow for multiple activations of the same node: The IC model is usually considered as a push model, since nodes (information sender) independently try to propagate information to connected nodes in the network. In contrast, the LN model can be considered as a pull model, where nodes (information receiver) accept information if many connected nodes have already accepted. In this case, acceptance of propagated information is determined by a random threshold. Even though Kempe et al. (2003, p. 138) found that also under the IC and LN model it is NP-hard to determine the target set of influential people, they were able to derive the first approximation guarantee for the proposed greedy algorithm by arguing that their objective function is monotone and submodular (for a more general model and further approximation algorithms cf. e.g., Chen et al. 2009; Leskovec et al. 2007). Moreover, the proposed approximation algorithm significantly out-performed heuristics based on centrality measures (Kempe et al. 2003). Even-Dar and Shapira (2011) apply another approach to solve the influence maximization problem, namely the so-called voter model. While the IC and LN model consider only the status of the network in the case of convergence to the steady state (Bonchi et al. 2011, p. 24), the voter model can be applied with different target times. Furthermore, it also overcomes a major limitation of the approach by Kempe et al. (2003), that is, the assumption that only one player introduces a product in the market. Besides Even-Dar and Shapira (2011), also Bharathi et al. (2007) and Carnes et al. (2007) suggested approaches for solving the influence maximization problem in a competitive environment.

Taken together, the first major research stream on the identification of influential people in social networks focuses on the strategic location while the second solves the influence maximization problem by applying diffusion models and (greedy) algorithms. However, as outlined within the introduction, these findings may not be transferred to OSN without further reflection. Therefore, we investigate which of the above mentioned and which further approaches are applied in the context of OSN in order to identify influential users. Furthermore, the specific evaluation of these approaches and implications for theory and practice shall be outlined. Hence, we address two further questions in the following:

Q.2   Which approaches have been developed and applied for the identification of influential users in OSN?

Q.3 How have these approaches been evaluated and which implications can be derived for theory and practice?

III.2.3 Literature Search

A systematic, comprehensive as well as replicable literature search strategy is regarded essential for a profound literature analysis on a certain topic of interest (vom Brocke et al. 2009). Bandara et al. (2011, p. 4) delineate two important cornerstones for the literature review process: First, one has to define which sources shall be searched (Webster and Watson 2002). Second, the precise search strategy needs to be defined, that is, relevant search terms, search fields, and an appropriate period of time (Cooper 1998; Levy and Ellis 2006). Finally, we outline the (number of) included and excluded articles and the selection procedure to allow for comprehensibility (vom Brocke et al. 2009).

III.2.3.1 Sources

In order to identify relevant publication organs, some authors suggest focusing on leading journals of the research discipline under investigation (Webster and Watson 2002, p. 16). However, as this restricts the search results beforehand, this approach should only be applied if the topic of interest can be narrowed down to specific journals. Elsewise, a broad database search is advised (Bandara et al. 2011, p. 4). As research on OSN is quite broad and wide-spread over diverse disciplines such as Management Science, Marketing, IS, or Computer Science, we conducted an extensive query in quality scholarly literature databases (cf. Table 1) (Levy and Ellis 2006, p. 189; vom Brocke et al. 2009, p. 8). We purposely accept duplicates instead of being limited to journals or conferences provided by a certain vendor (Levy and Ellis 2006, p. 189).

III.2.3.2 Search Strategy

For querying the scholarly databases, we derived the following search terms from literature, and applied them by string concatenations. As several synonyms for the terminology OSN can be found in literature, we searched for "social network" as an umbrella term to cover different term variations, such as Online Social Network or Social Network(ing) Site (cf. Richter et al. 2011). Additionally, we applied the search terms "influential" (covering also influential user), "influencer", "key user", "hub", and "opinion leader" (cf. Goldenberg et al. 2009, p. 1; Libai et al. 2010, p. 271). We searched the databases with these terms per title, abstract and keywords. As the first recognizable OSN SixDegrees launched in 1997 (Boyd and Ellison

2007), we chose a six-teen year period for our search spanning from 1997 to 2012. Table III-2.1 summarizes the search strategy.

Table III-2.1 Summary of the Search Strategy

Databases	AIS eLibrary, EBSCOhost, EmeraldInsight, IEEEXplore, INFORMS, ProQuest, ScienceDirect, SpringerLink, Wiley InterScience
Search Terms	("social network") AND ("influential" OR "influencer" OR "key user" OR "hub" OR "opinion leader")
Search Fields	Title, Abstract, Keywords
Time Period	1997 – 2012

III.2.3.3 Search Results

In order to determine the relevant articles with respect to our research questions (cf. section 2), at least two authors have screened all search results. Only such articles have been selected, that in essence provide a clear proposition on how influential users can be identified. Thereby, also at least one of the following criteria had to be fulfilled: (1) The article explicitly focuses on OSN, either as defined within the introduction or on OSN in general without further definition. (2) The article explicitly states that the derived results are applicable for OSN or the applicability is actually demonstrated by means of using an OSN data set.

The initial database query resulted in 1,912 articles. In a first step, we analyzed each article regarding its title, abstract, and publication organ in order to exclude all articles which obviously did not match our research focus. This reduced the set of articles to 180. In a second step, we examined these articles by a full-text review to verify whether an article corresponds to our research question and to assess the quality of the article's publication organ. Thereby, we excluded articles that were obviously not subject to some kind of formalized peer-review or quality verification (Levy and Ellis 2006, p. 185). Besides journals, also conferences[3] were considered (Webster and Watson 2002, p. 16) as they offer valuable contributions in the exchange of ideas and promote the development of new research agendas (Levy and Ellis 2006, p. 185). Articles that were too short for a thorough content analysis (e.g., contributions for a poster session) (Poeppelbuss et al. 2011, p. 509), and professional magazines, newspapers, or patents were excluded (Levy and Ellis 2006, p. 185). As the field of research on OSN is quite

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[3]   If workshop or conference papers were identified that have been published also in a journal, only the journal article has been considered when in essence the key findings remained the same.

young (Richter et al. 2011, p. 89), we also excluded books, as methods and theories need some time to be established and verified before being generally accepted. By this means, we obtained 12 mere approaches for the identification of influential users in OSN. By backward search, that is, by studying each article's references (Levy and Ellis 2006, p. 191), we located another four relevant articles. In summary, a set of 16 articles serves as the basis for our subsequent content analysis.

III.2.4   Findings and Critical Discussion

In the following, we analyze the relevant articles with respect to the delineated research questions. As all these articles deal with the identification of influential *people* in the context of OSN, we hereafter refer to them as influential *users*.

Q.1   *How are influential users characterized in the context of OSN?*

The broadly accepted fact that some people are more influential than others (Katz and Lazarsfeld 1955) seems to hold true also for OSN (Libai et al. 2010). As outlined in section 2.2, Katz (1957) observed in an offline context that personal influence is related to three (personal and social) factors, namely: "who one is", "what one knows", and "whom one knows" (Katz 1957, p. 73). These categories have been confirmed to be also applicable for a Web 2.0 con-text by Eccleston and Griseri (2008). To determine the influence of users in OSN, Eirinaki et al. (2012) deduced two properties, namely popularity and activity, together with several parameters for their measurement in OSN. Looking closely at the parameters of popularity suggested by Eirinaki et al. (2012), the factors "who one is" and "whom one knows" by Katz (1957) can be found to be covered. However, the original three (personal and social) factors need to be complemented by users' activity for the analysis of influence in the context of OSN: First, influential people in general tend to be more involved in personal communication than others (Weimann et al. 2007, p. 175). Second, users in OSN like Facebook have up to several hundred of friends whereof only a very small portion actually interacts (Heidemann et al. 2010) and some users are actually totally inactive (Cha et al. 2010). Consequently, pure connectedness of users does not necessarily guarantee for influence (Goldenberg et al. 2009; Trusov et al. 2010, p. 646). Additionally, implicit connections that cannot be gathered via explicit friendship connections between users, for instance, explicated via voting, sharing, or bookmarking, can be captured by accounting for users' activity (Bonchi et al. 2011, p. 6). Third, new possibilities induced by the previously unknown amount of data on users' activity allows for incorporating users' activity as further factor. Accordingly, we analyzed the relevant articles by means of the four (not mutually exclusive) factors "who one

is", "what one knows", "whom one knows", and "how active one is". Table III-2-2 illustrates the findings.

Overall, the majority of the relevant articles relies on rather broad definitions of influential users or stays imprecise about which characteristics are taken into account. Surprisingly, two factors ("who one is" and "what one knows") are hardly considered, although Zhang et al. (2011, p. 1512) find that different topics ("what one knows") lead to different results regarding the set of users that should be selected in order to influence most people in an OSN. In summary, we observe that current approaches barely consider user specific attributes as well as users' knowledge on certain topics.

Table III-2.2 Overview of the Characteristics Considered by the Relevant Articles

References	"Who one is"	"What one knows"	"Whom one knows"	"How active one is"
Aral and Walker (2012)	●	○	●	○
Canali and Lancellotti (2012)	○	○	●	●
Eirinaki et al. (2012)	●	○	●	●
Goldenberg et al. (2009)	○	○	○	●
Heidemann et al. (2010)	○	○	○	●
Hinz et al. (2011)[4]	○	○	●	◐
Ilyas and Radha (2011)	○	○	●	●
Kim and Han (2009)	○	○	●	●
Kimura et al. (2007)	○	○	◐	◐
Lerman and Ghosh (2010)	○	○	●	●
Ma et al. (2008)	○	○	◐	◐
Narayanam and Narahari (2011)	○	○	◐	◐
Saito et al. (2012)	○	○	◐	◐
Trusov et al. (2010)	○	○	○	●
Zhang et al. (2010)	●	○	◐	◐
Zhang et al. (2011)	○	●	◐	◐

Not Considered ○ *Considered* ● *Not further explicated* ◐

After the synthesis of how influential users are characterized within our set of articles, we examine the articles with respect to the proposed methods along with their evaluation and implications in the following.

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[4] Hinz et al. (2011) identify influential users in OSN by means of users' social position ("whom one knows") and thereby also reveal a significant correlation between users' social position and activity in OSN ("how active one is"). Based on a real-life viral marketing campaign of a mobile phone provider, the authors confirm the influence of these two characteristics on viral marketing success and further reveal a significant influence of customer characteristics ("who one is"). As we restricted our focus to OSN, however, these findings based on a telecommunication network have not been incorporated in Table 2.

Q.2   Which approaches have been developed and applied for the identification of

influential users in OSN?

Q.3   How have these approaches been evaluated and which implications

have been derived?

With respect to the two outlined major research streams (cf. section 2.3), six of the relevant articles apply approaches that are generally based on the strategic location of nodes in a graph (cf. Table III-2.3). Since a static and potentially inactive social link (often so-called "friendship relationship") in OSN does not guarantee an exchange of information and thus influence, Goldenberg et al. (2009) and Heidemann et al. (2010) define activity graphs were links be-tween users do not represent friendship connections but the activity of nodes (e.g., messages, visits). Based on a directed activity graph, Goldenberg et al. (2009, p. 5) identify influential users by looking for hubs "[…] with in- and out-degrees larger than three standard deviations above the mean". By analyzing Cyworld, the authors find that users with high degree centralities generally adopt earlier due to their large number of connections to other users. Furthermore, a user's innovativeness was estimated in terms of adoption timing across multiple products. The authors differentiate innovators (who adopt before anyone else in the neighbor-hood) and followers (who compromise the rest) and thereby reveal that the former mainly influence the speed of adoption and the latter market size. Thus, Goldenberg et al. (2009, p. 10) conclude that hubs "[…] could be an efficient target for word-of-mouth campaigns, leading to both faster growth and increased market size". Heidemann et al. (2010) define an undirected activity graph with weighted activity links representing the number of exchanged communication activities among users. By adapting the PageRank algorithm to account for the undirected and weighted graph, influential users are identified by means of high rankings among all users' PageRank scores. The authors apply their approach to a Facebook dataset and show that their algorithm allows to identify more users that can be retained as active users in the future than when drawing on other centrality measures or users' prior communication activity.

Besides these two articles focusing on the activity graph, the remaining four articles model a social graph consisting of social links, that is, friendship connections among users in OSN. Lerman and Ghosh (2010) argue that in general, dynamic social processes (e.g., information diffusion) as well as centrality measures to identify influential users can either be conservative (random walk-based) or non-conservative (broadcast-based). Since the diffusion of information is a non-conservative process, they hypothesize that accordingly non-

conservative centrality measures (e.g., degree centrality, (normalized) α-centrality) perform better than conservative ones (e.g., PageRank, betweenness centrality). By analyzing a Digg dataset, Lerman and Ghosh (2010) confirm this hypothesis and find that in their case (normalized) α-centrality performs best. Hinz et al. (2011), however, find that targeting users in OSN with both high degree (non-conservative) and betweenness centrality scores (conservative) is particularly beneficial as well-connected users are more likely to participate in viral marketing campaigns. The authors further observed that hubs do not have more influence on other users per se, they only use their greater reach more actively. In contrast to the so far discussed articles, Ilyas and Radha (2011) rather aim at identifying influential neighborhoods than single influential users. Therefore, they apply principal component centrality (PCC) in an undirected (weighted) social graph. Using the example of an Orkut and a Facebook dataset (in order to incorporate also user activity, the authors weight the social links by the number of users' interactions in the latter case), they show that in comparison to the application of eigenvalue centrality the number of identified influential neighborhoods and users can be increased by applying PCC. The authors further find that the tendency of eigenvalue centrality to identify a set of influential users within the same region of a massive graph of an OSN can be over-come by their proposed approach (Ilyas and Radha 2011). Finally, Kim and Han (2009) pro-pose to first rank users by their corresponding degree centrality scores in an undirected social graph. Second, the authors suggest identifying influential users by selecting the users with the highest centrality score and the highest activity index calculated as weighted the sum of selected activity indicators (e.g., number of groups, updated content per day). By analyzing the diffusion of a Facebook game, the authors find that targeting their identified influential users achieves increasing growth rates and higher number of new adopter than when addressing mediocrities (Kim and Han 2009). Table III-2.3 summarizes the approaches and findings.

Table III-2.3 Articles Focusing on the Strategic Location of Users in OSN

References	Approaches and Findings
Goldenberg et al. (2009)	Propose to identify influential users by looking for **hubs** in a **directed graph** based on **activity links**. Define hubs as users "[…] with both **in- and out-degrees larger than three standard deviations above the mean**". Analyze **Cyworld** and suggest targeting hubs, who lead to both **faster growth** and **increased market size**.
Heidemann et al. (2010)	Propose an **adapted PageRank** to identify influential users in an **undirected** and **weighted graph** based on **activity links**. Evaluate the approach by means of a **Facebook** dataset and find that **more users** that are **retained** can

	be identified than when users' prior communication activity (second best) or applying other centrality measures such as degree centrality (third best).
Hinz et al. (2011)	Propose **degree** and **betweenness centrality** to identify influential users in graphs based on **social links**. Apply different seeding strategies in **anonymous OSN** and customer networks. Find that **hubs** and **bridges** are **more likely to participate in viral marketing campaigns** and hubs use their greater reach more actively.
Ilyas and Radha (2011)	Propose **principal component centrality** (PPC) to identify influential users at the center of **influential neighborhoods** in an **undirected (weighted) graph** based on **social links**. Apply their approach to **Orkut** and **Facebook** and find that in comparison to the application of eigenvector centrality the **number of identified influential neighborhoods** and **users** can be **increased**.
Kim and Han (2009)	Propose to identify influential users by first computing **degree centrality** in an **undirected graph** based on **social links** and second estimating an **activity index**. Evaluate their approach by means of the diffusion of a **Facebook** game. Find that targeting their identified influential users **increases growth rates** and leads to **higher numbers of new adopters**.
Lerman and Ghosh (2010)	Propose **(normalized) α-centrality** to identify influential users in **non-conservative diffusion processes** in a **directed (weighted) graph** based on **active social links**. Evaluate the approach by means of a **Digg** dataset and find that the **non-conservative** model of **(normalized) α-centrality performs better** than conservative models of influence when identifying influential users in non-conservative processes such as **information propagation**.

Besides the six articles that apply approaches based on the strategic location of users in OSN (cf. Table III-2.3), another six of all relevant articles focus on solving the influence maximization problem (top-k nodes problem) by different approximation algorithms (cf. Table III-2.4). In contrast to the former ones, it becomes apparent that none of the latter ones, which will be discussed in the following, specifies whether the underlying directed or undirected graph is based on social or activity links. Four of the articles use SIR models (cf. section 2.3) to model the diffusion process. While Kimura et al. (2007) mainly focus on the design of an efficient approximation algorithm for the solution of the influence maximization problem based on bond percolation, Zhang et al. (2010) and Zhang et al. (2011) aim at incorporating more personal and social factors of influential users (cf. section 2.2) than solely their connectivity. Therefore, Zhang et al. (2010) incorporate similarity between users and Zhang et al. (2011) account for users' preferences for specific topics by weighting the graphs' links. Contrary to Kempe et al. (2003), Zhang et al. (2010) were able to show that due to richer information incorporated in the social graph, a degree-centrality-based algorithm performs often even better than the general and hill-climbing greedy algorithm. Narayanam and Narahari (2011) select a fundamentally different approach and suggest a Shaply value-based

influential nodes (SPIN) algorithm based on an appropriately defined cooperative game. The authors show that their algorithm can not only solve the top-k nodes problem investigated in all articles displayed in Table III-2.4, but also the λ-coverage problem, that is, finding a minimum set of influential nodes that influences a given percentage λ of nodes in the network. Furthermore, the authors show that their algorithm is more computationally efficient and yields a higher performance in terms of quality than the algorithms proposed by Kempe et al. (2003), Leskovec et al. 2007, and Chen et al. (2009). The article of Ma et al. (2008) differs as well from the previously discussed approaches. Instead of using a SIR model, the authors model diffusion by a heat diffusion process. Thus, the approach can not only capture users that diffuse positive information but also negative influence on other users (even if these users already adopted e.g., a product). Moreover, their approach allows for planning marketing strategies sequentially in time, as a time factor is included. Besides Ma et al. (2008), also Saito et al. (2012) take into account the time factor. Therefore, the authors apply a susceptible/infected/susceptible (SIS) model and define a final-time and an integral-time maximization problem. While the first problem cares only about how many nodes are influenced at a point in time, the second problem focuses on the question of how many nodes have been influenced throughout a period of time. By solving the two problems with a greedy algorithm, Saito et al. (2012) find that more influential nodes can be discovered than by applying approaches based on centrality measures. Furthermore, the identified influential users differ remarkably depending on the chosen influence maximization problem. Therefore, the authors conclude that "[…] it is crucial to choose the right objective function that meets the need for the task" (Saito et al. 2012, p. 632). Table III-2.4 summarizes the approaches and findings.

Table III-2.4 Articles Focusing on the Solution of the Influence Maximization Problem

References	Approaches and Findings
Kimura et al. (2007)	Examine the influence maximization problem (**top-*k* nodes problem**) using **SIR** models (namely the **IC** and **LT** model) in a **directed graph**. Solve the problem under the greedy hill climbing algorithm on the basis of **bond percolation** and demonstrate a **higher performance** and a large **reduction in computational cost** in comparison to the conventional method that simulates the random process many times.
Ma et al. (2008)	Examine the influence maximization problem (**top-*k* nodes problem**) using a **heat diffusion process** in a **directed** and an **undirected graph**. Solve the problem under a **top-*k*, *k*-step greedy**, and **enhanced *k*-step greedy algorithm**. Apply their approach to an **Epinion** dataset and show that not only

	the diffusion of positive but also of **negative information** can be modeled. Furthermore, the included **time factor** allows for planning viral marketing campaigns sequentially in time.
Narayanam and Narahari (2011)	Examine the influence maximization problem (**top-*k* nodes problem**) and the **λ-coverage problem** (finding a minimum set of influential nodes that influences a given percentage λ of nodes in the network) using a **SIR** model (namely **LT**) in a **directed graph**. Solve both problems by the **Shaply value** based influential nodes (SPIN) algorithm on the basis of a **cooperative game**. Show that the SPIN algorithm is **more powerful** and **computationally efficient** than existing algorithms.
Saito et al. (2012)	Examine the influence maximization problem (**top-*k* nodes problem**) using **SIS** models as **final-time** and **integral-time maximization problem** in a **directed graph**. Solve the problems under the greedy algorithm on the basis of **bond percolation**, **pruning**, and **burnout**. Find that **more influential nodes** can be discovered than by approaches based on **centrality measures** and that the **identified influential users differ remarkably** depending on the chosen problem.
Zhang et al. (2010)	Examine the influence maximization problem (**top-*k* nodes problem**) using a **SIR** model (namely **LT**) in a **directed graph**. Adapt the LT model by weighting edges that **account for similarity between users**. Solve the problem by applying **centrality**, **greedy**, and **combined algorithms**. Apply their approach to an **Epinion** dataset and show that the graph built by "trust" and "review-rate" includes more information on the social network. Thus, a **degree-centrality-based algorithm performs** often even **better** than the general and hill-climbing greedy algorithm.
Zhang et al. (2011)	Examine the influence maximization problem (**top-*k* nodes problem**) using a **SIR** model (namely **IC**) in an **undirected graph**. Adapt the IC model by weighting edges that **account users' preferences for specific topics**. Solve the problem under a CRLF optimized **greedy algorithm** including Monte Carlo simulation. Experimental results show that the approach significantly **outperforms the traditional greedy algorithm** in terms of information diffusion on **specific topics**.

Finally, four of the identified articles apply approaches for the selection of influential users in OSN which cannot be attributed to one of the two above mentioned research streams. The first article by Aral and Walker (2012) propose hazard models to measure the moderating effect of individual level attributes (e.g., gender, age) on influence, susceptibility, and dyadic peer-to-peer influence. By conducting a large scale in vivo randomized experiment in Face-book, bias by confounding effects, homophily, unobserved heterogeneity etc. could be eliminated (Aral and Walker 2012). The results indicate that there are remarkable differences be-tween the individual level attributes characterizing influencers and susceptibles. For instance, susceptibility decreases with age and women are less susceptible than men. Influence is also exerted mostly to users of the same age, men are more influential than women, and influential

users cluster in the network. Taken together, Aral and Walker (2012, p. 340) highlight that (1) influential users need to be targeted, since they are unlikely to adopt due to influence by other users, (2) "[…] being influential is not simply a consequence of having susceptible peers […]", as diffusion depends on both influence and susceptibility, and that (3) "[…] targeting should focus on the attributes of current adopters […] rather than attributes of their peers […]", since there are more users with high influence scores than with high susceptibility scores. Canali and Lancellotti (2012) as well differentiate and analyze "sources", that is, users that propagate information that receives the most attention of other users, and "targets", that is, users that access most information. The authors propose principal component analysis (PCA) to select and combine relevant user attributes (e.g., number of friends, number of comments). By applying their approach to a YouTube and Flickr dataset, they show that the approach is robust and effective, as it identifies more targets and sources than by applying in-degree centrality. Eirinaki et al. (2012) apply a similar approach and suggest selecting and combining a set of profile-based characteristics representing popularity (e.g., number of friends, received comments) and activity (e.g., number of updates, last login time). By applying their approach to a synthetic and MySpace dataset, the authors find that influential users that might have been missed by betweenness centrality or PageRank can be identified as not only users' connectedness but also activity is taken into account. To account for the importance of users' activity, Trusov et al. (2010) suggest a nonstandard form of Bayesian shrinkage implemented in a Poisson regression, which is based on users' daily log-ins. The authors apply their approach to an anonymous OSN and find that only few social links of a user have actually influence on his or her behavior. They further show that their approach identifies more users that influence others' activity than simpler alternatives such as degree centrality or an approximation by the number of a user's profile views. Table III-2.5 summarizes the approaches and findings.

Table III-2.5 Articles Focusing on Further Approaches

References	Approaches and Findings
Aral and Walker (2012)	Propose to identify influential users by applying **hazard models** to measure the moderating effect of **individual level attributes** on influence, susceptibility, and dyadic peer-to-peer influence. By conducting a large scale in vivo randomized experiment in **Facebook** it is shown that **susceptible decreases with age**, susceptibility **increases** with increasing **relationship commitment** until marriage, **men are more influential than women**, users

	exert most influence on other users of the **same age**, and influential users **cluster in the network**.
Canali and Lancellotti (2012)	Propose to apply **principal component analysis** (PCA) to **select and combine user attributes** that allow for identifying influential nodes. Differentiate between "**sources**" and "**targets**". Apply their approach to a **YouTube** and **Flickr** dataset to show that it is robust and effective. Find that their approach allows to **identify more targets** and **sources** than when applying in-degree centrality.
Eirinaki et al. (2012)	Propose to identify influential nodes by **selecting and combining** a set of **profile-based characteristics** representing popularity and activity. Apply their approach to a **synthetic** and **MySpace** dataset. Find that their approach allows for identifying influential users that might have been missed by betweenness centrality or PageRank as not only users' **connectedness** but also **activity** is **taken into account**.
Trusov et al. (2010)	Propose to identify influential nodes by a **nonstandard form of Bayesian shrinkage implemented in a Poisson regression**. Apply their approach to an **anonymous** OSN and find that only few social links of a user have actually influence on his or her behavior. Also their approach **identifies more users** that **influence others' activity** than simpler alternatives such as degree centrality or an approximation by the number of a user's profile views.

III.2.5   Future Research Directions

Online and offline social influence might not be the same.

Even though there have been first studies comparing offline and online social network constructs, such as tie strength (cf. e.g., Brown et al. 2007), many articles on the identification of influential users in OSN draw on theories and previous findings that have been originally derived in an offline context without critical reflection (cf. section 2.1). For instance, the visibility of social actions in OSN might lead to new forms of social influence, "[…] which rather than flowing from the actor to the observer, flows from the observer to the actor" (Sundararajan et al. 2012, p. 8). Thus, companies might be able to develop marketing strategies that "[…] incorporate targeting advisees, not just advisers", as suggested by Hinz et al. (2013, p. 8). Future research should therefore especially focus on differences and commonalities of offline and online networks (Howison et al. 2011, p. 773). Are there differences between online and offline social systems, and if yes, what are these differences? Are online influencers also influential offline and vice versa? Are online traces reliable mirrors of offline social influence and contagion and does social influence invoked in online settings further spread into the offline world? More work regarding such questions should be encouraged and practitioners need to be aware that concepts developed offline might not work alike in online settings such as OSN.

BISE and Marketing could mutually benefit from more collaboration.

We find that most articles on the identification of influential users in OSN steam either from the scientific Business & Information Systems Engineering (BISE) or Marketing community. Taken together with our findings presented in section 4, it becomes apparent that marketing-oriented articles extensively draw on rich real-world datasets of OSN and even collaborate with OSN providers (cf. e.g., Trusov et al. 2010). In contrast, technical-oriented papers from the field of Computer Science and Engineering have a more theoretical approach and evaluate their artifacts in most cases by formal proofs, for instance regarding efficiency, run-time, or in a few cases apply synthetical or other networks' data (e.g., authorship networks) (cf. e.g., Narayanam and Narahari 2011). This may account for the fact that some of the central findings of these rather design-oriented articles are contrary to empirical findings from the Marketing community (e.g., regarding the applicability of degree centrality for the identification of influential users in OSN). Therefore, we believe that an even stronger collaboration between the scientific BISE and Marketing community than we find today could be mutually beneficial by exchanging data on OSN, knowledge about efficient and automated algorithms that actually can handle the vast amount of data in OSN, or contacts to OSN providers. Furthermore, the actual design and implementation of algorithms in cooperation with companies or OSN providers, for instance by conducting Action Design Research (cf. Sein et al. 2011), could be facilitated in future research. To do so, however, access and privacy challenges need to be overcome in order to acquire reliable data (Howison et al. 2011, p. 775; Lazer et al. 2009, p. 722). Therefore, "[r]obust models of collaboration and data sharing between industry and academia are needed" and "[r]esearchers themselves must develop technologies that protect privacy while preserving data essential for research" (Lazer et al. 2009, p. 722).

A human being and his or her behavior are not just nodes and links in a graph.

The majority of the articles do neither incorporate personal information on users that allows for assessing "who one is" or "what one knows" (cf. Table III-2.2). However, Trusov et al. (2010, p. 645) and Hinz et al. (2011, p. 68), for instance, find that having many friends (i.e., social links) does not make users influential per se. Thus, focusing solely on "whom one knows" (cf. Table III-2.2) might not be sufficient to identify influential users in OSN. Instead, there is remarkable heterogeneity among users in OSN, that is, the average user is influenced by relatively few other users and in turn, influences few other users (Trusov et al. 2010, p. 645). Prior research states that "[…] influence […] cannot be simply traced back to the graph

properties […] but also depends on the personality and emotions of the human being behind it" (Quercia et al. 2011, p. 1). Furthermore, it has been emphasized that influence is not a "[…] unidimensional measure, but a combination of personal traits with social network positioning […]" (Weimann 1991, p. 276). However, empirical studies of how individual attributes of users moderate influence can hardly be found. A first study by Aral and Walker (2012) finds that influence and susceptibility of users heavily depends on the individual level attributes of users (e.g., age, gender). This is also confirmed by Katona et al. (2011), who find that some demographic variables are good predictors of adoption. On the other hand, influence is often over-estimated, as homophily actually accounts for a large share of social contagion (cf. section 2.3). Zhang et al. (2011) emphasize that the identification of influential users also depends on users' preferences for specific topics as the diffusion of information differs among topics (cf. e.g., Saito et al. 2009; Saito et al. 2010). Thus, practitioners targeting influential users in OSN should take into account not only the specific characteristics of the users but also of their advertised products and services. We consequently believe that more research is needed to investigate the relationships between the personal and social factors of influential users, the distribution of these factors across users, and the homophily in the formation of social and activity links in OSN. With respect to these links, also questions regarding the selection and combination of different link types (e.g., social and activity links), their intensity (e.g., denoted by weights based on the number of communication activities, cf. Heidemann et al. 2010), and the role of missing links (e.g., does the absence of traces for a link in the dataset under consideration provide evidence for the absence of social influence?) should be addressed in more detail in future research (Howison et al. 2011).

Not just positive information might be propagated.

Besides the article by Ma et al. (2008) (cf. Table III-2.4), none of the analyzed articles explicitly models the diffusion of positive and negative information in OSN. However, prior research on word-of-mouth in general found that negative word-of-mouth is more likely and stronger than positive word-of-mouth (Anderson 1998; Bone 1995): While on average dissatisfied customers can be expected to tell eleven persons, satisfied only tell about five persons about their experiences (Heskett et al. 1997). Thus, negative word-of-mouth is about twice as likely as positive word-of-mouth (Mangold et al. 1999). Also in an online context, Chevalier and Mayzlin (2006) found that the impact of a negative review on sales was greater than the impact of a positive one and Berger and Milkman (2012) showed that content provoking negative emotions such as anger or anxiety tended to be exceptionally viral. Therefore, practitioners need to be aware that targeting influential users in OSN can also

incorporate a certain risk of negative information diffusion. In order to better understand the role of influential users propagating negative information in OSN, future research should also develop diffusion models that incorporate a certain degree of (influential) users that do not solely or doubtless spread positive information.

The one who leads might not follow.

Most of the discussed approaches (cf. section 4) try to identify the most influential users that should be targeted in order to maximize the impact of a marketing campaign. However, as Watts and Dodds (2007, p. 442) state, "[…] it is generally the case that most social change is driven not by influentials but by easily influenced individuals influencing other easily influenced individuals". Aral and Walker (2012) point out that the susceptibles hypothesis is for instance well represented in theoretical threshold-based models (cf. section 2.3), which are also used by some of the approaches discussed in section 4 (cf. Table 4). However, besides Aral and Walker (2012) and partly Canali and Lancellotti (2012), none of the discussed articles analyzes the role of susceptibles in depth. Particularly behind the backdrop of the findings of Aral and Walker (2012) outlined in section 4, it still seems to be promising for practitioners to address influential users in OSN, but further research is needed to enrich our understanding of the role of susceptibles and their individual characteristics as well as their interplay with influential users in OSN (cf. e.g., Hinz et al. 2013).

You are not alone.

None of the discussed articles considers optimal seeding strategies in a competitive environment. However, due to the sheer size and the high number of connections to other users in OSN, isolated diffusion processes may not be representative for reality. Furthermore, users in OSN are exposed to a tremendous amount of information (Canali and Lancelotti 2012, p. 29). This information overload may cause users in OSN to be less easily influenced as they simply cannot process all the information that they are exposed to (Hinz et al. 2011, p. 58). Therefore, practitioners need to be aware that competing marketing campaigns or information over-load may diminish the effects of viral marketing campaigns. We believe that further research is needed to better understand the consequences of parallel (competing) viral marketing campaigns, for example regarding different products of one company or simultaneous marketing campaigns of different companies, and the impact of information overload.

Degree centrality is not that bad.

Our analysis shows that most articles focusing on the solution of the influence maximization state that their approaches outperform simpler approximations such as degree centrality (cf. Table III-2.4). However, this is in contrast to a number of articles, which find that particularly users with high degree centrality scores (i.e., hubs), are in fact the influential users in OSN (cf. Table III-2.3). This finding is also verified by Zhang et al. (2010), who show that degree centrality-based algorithms perform often even better than greedy algorithms when approximating the optimal solution of the influence maximization problem. This might be due to richer information, which is incorporated in social graphs of OSN (Zhang et al. 2010). Also Tang and Yang (2010) find in a similar context that a simple degree centrality based algorithm performs almost as good a complex PageRank based approach. One explanation for these deviating results could be the different evaluation methods as outlined above. In line with related studies (e.g., Kiss and Bichler 2008) we find that degree centrality can be a reasonable measure for the identification of influential users in OSN. However, practitioners targeting users with high degree centrality scores need to be aware of further findings, which indicate that the influential power of users and susceptibility decreases with a rising number of contacts (e.g., Katona et al. 2011; Narayan et al. 2011). Moreover, some articles indicate that users with high degree centrality scores do not have higher conversion rates due to a higher persuasiveness but are rather more active (e.g., Hinz et al. 2011; Iyengar et al. 2011b). Thus, further research on the optimal centrality of influential users, the actual role of social influence in OSN, and further validations using large-scale data from actual OSN should be encouraged.

Methods, diffusion processes, and network properties need to be aligned.

As Lerman and Ghosh (2010) point out, the diffusion of information is a non-conservative process. However, not only the diffusion process but also centrality measures make implicit assumptions about the nature of the diffusion process (Borgatti 2006). Therefore, the actual underlying diffusion process affects the applied approaches (Ghosh et al. 2011), which hence need to be aligned accordingly. However, for instance Hinz et al. (2011, p. 69) find that it is beneficial to target users with high betweenness centrality scores. This is a conservative centrality measure (Lerman and Ghosh 2010) applied in the context of viral marketing campaigns, whereby diffusion is usually considered as a non-conservative process (Ghosh et al. 2011). Furthermore, Narayanam and Narahari (2011, p. 145) find that "[t]he presence of communities strongly affects the process of identifying influential nodes". This is in line with findings by Kimura et al. (2008), who found that certain community structures are strongly

correlated with the greedy solution of their influence maximization problem under the IC model. Ilyas and Radha (2011) go one step further and identify users that form centrality maxima within influential neighborhoods. This is a promising approach for future research, as it is hardly the case that there is only a single influential neighborhood in OSN with millions of users. Consequently, several users might have relatively low influence scores compared to the whole OSN, but relatively high influence scores within their relevant neighborhoods. Therefore, practitioners and researchers should carefully consider and align their applied methods and approaches to the underlying diffusion processes and network properties when identifying influential users in OSN (cf. Howison et al. 2011, p. 790 f.). However, since not all studies confirm the propositions of Lerman and Ghosh (2010), further research should be encouraged to achieve a deeper understanding about the interplay of centrality measures and diffusion processes.

Efficiency and validity are crucial.

Taking a look at the articles focusing on the solution of the influence maximization problem by using diffusion models and solving them by (greedy) algorithms (cf. Table III-2.4), it becomes apparent that the efficiency of the applied algorithms is a crucial success factor for their applicability in a real-world context (Saito et al. 2012). Therefore, as discussed above, solutions based on well-established centrality measures from SNA are often favorable, even though more sophisticated algorithms might be more accurate (cf. e.g., Zhang et al. 2011). However, the application of SNA in new contexts such as OSN raises several challenges and corresponding validity issues (cf. Howison et al. 2011 for an overview). For instance, building an activity graph requires the aggregation of activity links over time (cf. e.g., Heidemann et al. 2010). This might lead to "[…] networks with different structural properties than the network experienced by participants" (Howison et al. 2011, p. 784), which offers starting points for future research. Taken together, practitioners and researchers need to be aware of the trade-off between high accuracy as well as validity and sufficient efficiency for large-scale datasets of OSN. Further research could thus also address questions of optimal levels of accuracy and efficiency from an economical perspective when identifying influential users for marketing purposes in OSN.

III.2.6   Conclusion

Who will lead and who will follow? The question of identifying those people that mobilize and propagate influence in networks and society the most effective way has been intensively analyzed in different research streams over the last decades. Along with the explosive growth

of OSN, related changes regarding access and availability of user data, a decreasing impact of traditional marketing techniques, and changes in customer behavior, identifying influential users in OSN received a great deal of attention in recent years. With this context at hand, we focused on identifying relevant publications by means of a structured literature search in order to analyze, synthesize, and assess applied characteristics of and methods for identifying influential users in OSN. It is hoped that the results can stimulate and guide future research in the field.

However, our findings are subject to limitations: First, despite we conducted a broad and structured database search there is still a certain chance that not all relevant articles have been identified. Furthermore, we selected appropriate search terms derived from literature, but nevertheless additional phrases might have also uncovered a few more relevant papers. Second, by our focus on OSN we excluded articles that analyze content-oriented sites such as Twitter or YouTube. Thus, our perspective is narrowed and certain approaches and findings that have only been researched on such sites are not considered. Future research could build upon the presented findings when first extending the analysis to also content-oriented sites and second investigating commonalities and differences regarding the identification of influential users in content-oriented sites and OSN. Additionally, the focus on influential users in OSN could be broadened in the future in order to discuss also commonalities and differences of social influence in online and offline settings. Further research might therefore apply a broader definition of OSN and incorporate also studies on offline networks. Besides these limitations, we hope that our findings help interested parties from BISE, Marketing, and beyond to get a first overview and better understanding of the body of knowledge regarding the identification of influential users in OSN. Additionally we hope to provide directions for future research in this field.

III.2.7 Literature

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IV   Summary and Future Research

In this section, the key findings of this doctoral thesis are summarized (section IV.1) and potential starting points for future research are presented (section IV.2).

IV.1   Summary

The main objective of this doctoral thesis was to contribute to the field of CRM with a particular focus on the challenges and opportunities that have arisen with the trends *Corporate Sustainability* and *Digitalization*. With describing the manifold aspects, classified along the layers of an enterprise architecture that have to be taken into account when incorporating sustainability, section II focused on a business transformation towards sustainability. The alignment of business model, underlying processes, services, applications, and infrastructure towards customer expectations as well as the requirements and key success factors of an appropriate project management for such transformation projects were discussed. Section III concentrated on sustainable CRM in a digitalized world. To build a proper multichannel offering and target "the right customers", meaning valuable customers to a company, user preferences regarding channel usage were investigated and approaches, how to identify "key users" within OSN were outlined by analyzing the state of the art, conducting a critical review of existing literature. In the following, the key findings of the research papers included in this doctoral thesis are presented, for section II and III respectively.

In section II, several aspects of a business transformation towards sustainability were investigated:

- Research paper 1 focused on the interplay of customer expectations in the context of sustainability and resulting requirements for a company's business model. The major factors that influence decisions on sustainability targets and sustainability investment levels were derived from sustainability disclosure literature (Objective II.1). The developed mathematical approach allows to simultaneously determine both, the optimal communicated sustainability target and the investment level (objective II.2). It takes into account customer expectations, which are an important indicator, as customer behavior determines business success. At the same time, it deals with the trade-off between corporate sustainability and business targets, i.e. it takes care of the ambiguous role of the economic sustainability dimension in the business context, which emerges as additional organizational incentive to ensure business success in accordance with the paradigm of value-based management (Seidel et al. 2010).

Whereas other potential solutions might only provide a sequential decision on the communicated sustainability target and the sustainability investment level, the approach allows a simultaneous optimization of both. By applying the approach, using the example of a German beverage company, its practicability has been demonstrated und useful insights for future operationalization scenarios have been derived (Objective II.3).

- The Sustainability Maturity Cube as a blueprint, presented in research paper 2, helps identifying the field of action for the transformation towards sustainability by structuring an organization's processes along the value chain for the three dimensions of sustainability (Objective II.4). As the Sustainability Maturity Cube adapts the basic idea of stages of development and maturity (i.e. maturity models) to the sustainability context, it is moreover possible to capture the progress of sustainability actions within each corporate activity and dimension of sustainability. In a second step, taking into account the ambiguous role of the economic sustainability dimension in the business context, the developed decision model allows economically evaluating a company's transformation towards sustainability, in line with the paradigm of value-based management. This is of great interest, as the effects of ecological and particularly social actions are difficult to valuate and thus decision makers tend to neglect their economic consequences so far. To evaluate, whether the approach proves useful for subject matter experts who are involved in sustainability decisions, a first example was provided for how a specific company can transform towards sustainability. The Sustainability Maturity Cube was instantiated using Porter's value chain (Porter 1985) to structure the corporate activities (1st dimension of the cube) and the sustainability maturity model of Cagnin et al. (2011) to capture the progress of sustainability actions (2nd dimension) besides the three dimensions of sustainability (3rd dimension). The proposed decision model was furthermore applied to evaluate the economic effects of the implementation of the identified sustainability actions (Objective II.5). The exemplary operationalization of the approach was also particularly helpful to identify difficulties that come along with the application of the approach and thus pointed out starting points for future research.

- When transforming towards sustainability, large parts of an organization are affected, thus an appropriate project management is needed to support project success. Research paper 3 pointed out the requirements for a successful project management of transformation projects. First, challenges of (IT) transformation projects were

emphasized and a possible structure and procedures based on the experience of a transformation project in the banking sector were illustrated (Objective II.6). Afterwards the key requirements for a successful project management were derived from the experiences in this transformation project. Accordingly, key performance indicators need to be intersubjective verifiable, i.e. independent of individual emotions and preferences. Secondly, they need to be easily aggregated or broken down according to the necessary granularity of a reporting. Hence, suitable management dimensions and corresponding key performance indicators that can be used to measure project success were identified (Objective II.7). Thereby, budget consumption, progress and quality were derived as reporting dimensions that should be recorded in all release phases of a project. With regards to an appropriate tool support for project management, standard software and individual "in-house" solutions were challenged to work out pros and cons of these two options, with the result, that often a mixture of both ways seems to be the best solution (Objective II.8). Although the paper's contribution bases on the banking context, its results can be transferred to the sustainability context, as the challenges, the key requirements for a successful project management, and related performance indicators resemble those for a business transformation towards sustainability in terms of project characteristics or requirements for its management for instance.

Section III focused on sustainable CRM in a digitalized world. To provide an appropriate multichannel offering and target the right customers within these channels, several aspects have to be considered.

- Research paper 4 focused on the preferences of users regarding channel usage for online and offline channels with respect to the services provided. Data of 500 citizens and 500 companies were collected together with the German Federal Employment Agency (Bundesagentur für Arbeit). The survey was conducted by phone and the participants were inquired about their channel preferences (online, in person, by phone, by letter) with regard to eleven different services of the German Federal Employment Agency, classified along its four categories of services, namely information services, transaction services, service requests, and counseling services. The conducted case study indicates that users ask for a multichannel offering. They prefer to deliberately choose subjectively suitable channels for different services (Objective III.1). The perceived usefulness of e-services thereby determines the

intention to use these services and for some services, like counselling services, for instance, trust is assumed to affect the perceived usefulness and thus the choice of the service channel. To provide a comprehensive offering, companies can pursue an omnichannel strategy, in order to give customers a unified experience across all channels (van Bommel et al. 2014). However, although users prefer to choose suitable channels themselves, when developing a multichannel strategy it might not be reasonable, from an economic point of view, to provide all channels for all services offered, given that some channel characteristics like costs, product fit, or customer acceptance vary greatly (Objective III.2). Thus, future research should evaluate implementation strategies and consequences for different categories of services, like information, transaction, or counseling services and against the background of different customer segments.

- The objective of research paper 5 was to outline fundamental research on social influence, influential people, and their identification in social networks before the rise of OSN, and to analyze and synthesize the growing number of publications on the identification of influential users in OSN for targeted customer interaction within those networks (Objective III.3). To achieve these objectives, three research questions have been derived: (1) How are influential users characterized in the context of OSN? (2) Which approaches have been developed and applied for the identification of influential users in OSN? (3) How have these approaches been evaluated and which implications have been derived (cf. I.2.2)? Conducting a structured literature search, it has been found that the majority of existing studies characterizes influential users as particularly well-connected and active users within OSN. The analysis further revealed that research on the identification of influential users mainly either focuses on users' strategic location, for instance by applying centrality measures, or aims at solving the influence maximization problem by applying diffusion models and (greedy) algorithms to identify influential users in OSN. Regarding the evaluation of the approaches, it became apparent that most marketing-oriented articles draw on real-world datasets of OSN, while rather technical-oriented papers usually evaluate their artifacts by formal proofs. Based on these findings, a research agenda has been elaborated on to motivate and guide future research.

Taken together, it can be concluded that the corresponding research papers included in this doctoral thesis contribute to existing literature in the field of CRM with a particular focus on the effects of "aligning" to *Corporate Sustainability* and profit from *Digitalization* as

"enabler". Despite the presented findings, however, further challenges remain and offer starting points for future research.

IV.2   Future Research

In the following, potential starting points for future research are highlighted for each research paper included in this doctoral thesis.

Section II: Regarding business transformation towards sustainability, there are several aspects for future research that are addressed in the following paragraphs:

The approach developed in research paper 1 allows to simultaneously determining the optimal communicated sustainability target and investment level. It takes into account customer expectations, which are an important indicator, as customer behavior determines business success. Furthermore, it deals with the trade-off between corporate sustainability and business targets and, with this, considers the ambiguous role of the economic sustainability dimension in the business context. However, the results have to be seen in the light of some limitations:

- First, it is debatable whether consumers' purchasing behavior is really influenced by companies' communicated sustainability targets and respective investment levels. Although a strong consideration of sustainability aspects is assumed (cf. Auger et al. 2003, Auger et al. 2008, Auger et al. 2010, Collins et al. 2007), this might not always be reflected in buying behavior (cf. Bonini and Oppenheim 2008, Bellows et al. 2008, Fisher 1993, Pickett-Baker and Ozaki 2008). Furthermore, only one homogeneous consumer group was considered in the model, not further differentiating customer segments by taking into account different behavior of consumer groups like LOHAS (Ray and Anderson 2000), compared to consumer groups less sensitive regarding sustainability issues, for instance. Thus, to better model real world conditions, heterogeneous customer segments should be considered. Against this background, also the classification of sustainability performance as a one-dimensional attribute (cf. Kano et al. 1984) can be discussed and should be modified for respective customer segments in future research.

- Second, potential rebound effects have been neglected in the model so far: Additional demand for products due to good sustainability performance increases sales, which in consequence increases negative environmental impacts due to a higher output quantity. Adding reporting on a relative basis to the absolute view could solve this problem. Furthermore, only one sustainability indicator has been evaluated at a time. In doing so, potential interdependencies (positive as well as negative) have not been

considered in the approach. Future research should thus focus on synergies and rivalries of implementing different sustainability initiatives at the same time, and accordingly consider those effects in the evaluation.

In research paper 2, the Sustainability Maturity Cube was developed, a blueprint that can serve as a basis for developing concrete sustainability maturity models. In line with future research suggested above, enhancing and further validating the results of research paper 1, also for research paper 2 it holds true, that the empirical evidence of whether all customers care about sustainability issues and express their concerns through purchasing behavior and price sensitivity is debatable. Moreover, some other limitations provide room for further research:

- The triple-bottom-line concept and the understanding of sustainability in the Brundtland Report share the belief that sustainable development requires implementing all dimensions, i. e. all pillars of sustainability equally and at the same time, as they are complementary, but not interchangeable (cf. "strong sustainability", Figge et al. 2001). Indeed, the parallel implementation of all dimensions of sustainability can be complementary, but also rival. As targets in the social or ecological dimension are not necessarily targets from an economic perspective, there may result conflicts, especially in a short-term view. In contrast to that, weak sustainability is based on a theory within ecological economics saying that the different existing sorts of capital, i. e. human (social dimension), natural (ecological dimension), or manufactured capital (economic dimension) can be substitutes for each other (Cieges et al. 2009). Weak sustainability thus does not account for possible negative externalities (e.g. consequences of consumption of dwindling resources) caused by the substitution with capital. Future research should work on a clear definition, understanding, and operationalization of (corporate) sustainability. Guidelines, describing how to account for the consequences of complementary or rival effects of the three dimensions of sustainability should be elaborated on. Against this background, especially the ambiguous role of the economic sustainability dimension in the business context has to be considered and further evaluated.
- The developed Sustainability Maturity Cube describes on a meta-level that the three perspectives (1) Corporate Activities, (2) Sustainability Maturity Levels, and (3) Dimensions of Sustainability need to be considered in business' transformation towards sustainability. Of these three perspectives, only the operationalization of the Dimensions of Sustainability was fixed (cf. triple-bottom-line concept, Elkington 1997). Regarding the other two perspectives, applicable frameworks like Porter's

value chain and maturity models have only been suggested and were not further predefined. Future research could thus focus on the evaluation and operationalization of other frameworks applicable to describe the perspectives Corporate Activities and Sustainability Maturity Levels.

- To keep the generic character of the approach, in this research paper, a concrete sustainability maturity model was not instantiated. Consequently, no definitions regarding "measurement points" or "specific scenarios" were elaborated on. Furthermore, no "confounding effects" were considered nor has a "clearly predefined concrete development path" been described, which would be necessary in case of building a maturity model, i.e. an instantiation of the blueprint. However, some of these points were addressed in the operationalization of the approach, which aimed at providing first insights in the substantiation, i.e. building of a concrete sustainability maturity model, but the findings were not aimed at making generalizations. Future research should focus on guidelines for the operationalization of the Sustainability Maturity Cube and a more extensive evaluation of the approach, for example for the context of different industries.

Research Paper 3 emphasized the challenges that exist in IT transformation projects and elaborated on how these projects can be structured and managed. Key requirements for a successful project management were deduced, and according key performance indicators to fulfill these requirements, as well as suitable tool solutions to support project management have been suggested. The paper is based on an IT transformation project in the banking context and best practices were deduced based on the experiences made in this single project. Future research could challenge the results of this work, e.g. regarding the chosen key performance indicators or software solutions for example. In addition, other experiences, e.g. in other industries or against other contexts of transformation projects could be analyzed to further work out key success factors of successful transformation projects.

Summarizing, for business transformation towards sustainability, there exist several open issues regarding a clear understanding of (corporate) sustainability and its operationalization along with the paradigm of value-based management. Against this background, guidelines are necessary that help companies to integrate sustainability issues in their business strategy, processes, services, and products. In addition, further empirical research needs to elaborate on the interplay of customer expectations regarding "the sustainability of a company" and the related effects on buying behavior or price sensitivity in order to quantify these effects. Regarding the transformation process itself, an overview on experiences and best practices

e.g. in other transformation projects might help to learn from and identify the key requirements and management approaches that lead to a successful transformation in the sustainability context.

Section III: Regarding sustainable CRM in the context of a digitalized world, there also exist several aspects for future research, which are addressed in the following.

In research paper 4, the preferences of e-government service adoption of citizens and business users were investigated. Thereby, the contributions of this article have to be seen in the light of some limitations that provide room for future research.

- The study in this research paper was conducted only in one country and for one, albeit large public sector institution (German Federal Employment Agency/Bundesagentur für Arbeit). In order to validate the results of this case or to find evidence, such as for cultural differences, future research is needed. Researchers should thereby focus on further cases, for example, in other countries. Moreover, to find out if adoption preferences differ for services provided by governmental institutions or by private businesses, future research should also investigate and compare preferences or usage rates for services provided by companies, e.g. for the business-to customer or business-to-business sector.

- Second, in order to sustainably develop and manage a multichannel strategy, it is one the one hand necessary, to further classifying user groups in order to better customize offerings, for instance, according to demographic aspects or respective industries. On the other hand and in line with a value-based management, research should also evaluate the economic effects of multichannel offerings. Although the conducted survey indicates that users prefer to choose individually suitable channels by themselves, it might not be reasonable from an economic point of view, to provide all channels for all services. Future research should hence evaluate implementation strategies and consequences for different categories of services, like information, transaction, or counseling services and against the background of different customer segments.

In research paper 5 a critical review of existing literature on identifying influential users in OSN is conducted. Besides the possibility that not all relevant articles have been identified, although a broad and structured database search has been conducted, also the fact that the search was narrowed only to user-oriented OSN neglects findings that have been derived in

articles, e.g. focusing on content-oriented sites such as the microblogging site Twitter or the video channel YouTube, or the offline world.

- Future research could therefore broaden its focus by also considering commonalities and differences of social influence in other online settings like all types of OSN and sources of user-generated content and platforms that support customer-to-customer interactions like social shopping communities or forums with recommendations of and for other users.

- Likewise, with the aim of better targeting those "right customers" who are influential in terms of bringing value to the company by adopting and/or diffusing new products or services, the focus of future research on influential users should also be broadened regarding commonalities and differences of social influence in online and offline settings. Further studies might particularly investigate questions at the interface of online and offline worlds, in order to learn more about social influence that disseminates from online to offline settings for example.

Summarizing, there is room for further research to sustainably manage customer relationships in a digitalized world. First, concerning channel offerings, it seems that "multichannel" is the answer, instead of letting everything end up being solely digital. Nevertheless, to develop multichannel strategies considering economic effects and to customize multichannel offerings to respective application contexts and user groups, further research is needed. Second, to identify "the right customers" e.g. for marketing campaigns, the knowledge about customers, their behavior, and their social influence has to be further investigated in and especially at the interface of online and offline world.

Taken together, the research papers presented in this doctoral thesis contribute to CRM in the context of corporate sustainability and a digitalized world. Even though this doctoral thesis can answer some questions regarding the interplay of customer expectations on corporate sustainability on the one, and the opportunities and downsides of a digitalized world on the other side, the challenges that arise with these trends will remain a hot topic in research and practice over the next years. It is hoped that this doctoral thesis can contribute to this endeavor by offering new insights and starting points for future research in order to face the challenges of our ever-changing environment.

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