Mario Schaarschmidt

Firms in Open Source Software Development

Managing Innovation Beyond Firm Boundaries

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RESEARCH

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Foreword by Prof. Dr. Harald von Kortzfleisch

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Foreword

Since Henry Chesbrough introduced his book Open Innovation in 2003, many researchers have contributed to our understanding of innovation as a phenomenon not soly domiciled within the boundaries of the firm. In particular, both the integration of external sources into corporate innovation processes as well as the external exploitation of innovations generated within the boundaries of the firm have been investigated. Prevalent in this discussion seems to be that (1) external resources can complement the firm's own resource base and (2) integration of these resources may lead to increased innovative perfomance.

As the example of open source software furher shows, firms not necessarily have to pay for such external resources to obtain. In these scenarios, individuals provide their knowledge for free, by, for example, reporting bugs, requesting new features or - at least in smaller projects - contributing pieces of code.

However, this advantage of getting access to external resources comes at larger coordination and control costs that may outperfom the benefits. For instance, in the case of open source software, the number of participants could - theoretically - be very large which makes it difficult for a firm to influence a project's trajectory. Yet, *how* firms control what happens beyond their boundaries - and beyond their vertical command chain - is outside of our knowledge.

With this book, Mario Schaarschmidt contributes to the understanding of the open innovation phenomenon by focusing on a part that has not received much attention yet: managaging, and therefore pursuing control, beyond the boundaries of the firm.

This book is Mario Schaarschmidt's doctoral thesis at University of Koblenz-Landau and depicts a starting point of a fruitful academic career. While wishing the readers the same interesting insights I had when reading Mario's dissertation, I can recommend it to academics and practitioners alike.

Prof. Dr. Harald von Kortzfleisch

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Preface

I would like to take this space to thank all those who made this dissertation possible. First and foremost, I have to thank Harald von Kortzfleisch, my thesis advisor, for giving me the freedom to be creative within my thesis and for providing me with necessary (financial) resources to become a better researcher. Harald, without your support, this thesis never could have been done. Second, I thank Gianfranco Walsh for taking over the part as a second supervisor and for his British humor which helped me to survive dark hours during the completion of this thesis.

Furthermore, I want to thank my parents, Ursula and Rainer, who took over lots of inconvenient tasks in everyday life so I was able to concentrate on this thesis. Same holds true for my Grandma and my sister, Ute.

I further like to warmly thank people at the University of Koblenz-Landau, in particular Thomas Kilian, Berthold Hass, Matthias Bertram, and Nadine Lindermann, for numerous valuable discussions and suggestions. A number of great researchers guided my way to this dissertation. While working as a student at WHU - Otto Beisheim School, I have been inspired by Ulrich Lichtenthaler. Ines Mergel hosted me at Harvard's Kennedy School and gave me a wonderful opportunity to enrich my knowledge base. Finally, I have to thank Linus Dahlander for the work I could build upon as well as Ricco Deutscher for an invaluable interview on open source strategies.

I also like to thank participants of several conferences and workshops I attended for valuable comments of parts of this thesis and for broadening my scope. These meetings were, amongst others, various European Academy of Management Conferences (EURAM), the 8th User and Open Innovation Workshop, MIT Sloan School of Management, Cambridge, MA, the Paper Development Workshop, Academy of Management Annual Meeting (AOM), OCIS Division, Montréal, Canada, and the PhD Seminar on Open Innovation at ESADE Business School, Barcelona, Spain.

For support in generating this thesis I would further like to thank Christoph Schneider whose Master Thesis provided valuable input to parts of the thesis and the 2008 research project team on open source software for collecting data in one case.

Finally, I would like to thank my girlfriend Nadine for her lenience and support.

Mario Schaarschmidt

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Chapter 1

Introduction

1.1 Motivation

In the software market, the recent trend seems to be moving toward the development, use, and adoption of open source software (OSS). Various venture capital (VC) deals and acquisitions of OSS firms by large software vendors document the increasing prevalence of OSS in business (Von Kortzfleisch et al. 2010), such as the acquisition of JBoss by RedHat in April 2006 for approximately $ 350 million,[1] the acquisition of Sleepycat by Oracle in February 2006[2] or the $ 1 billion acquisition of MySQL by Sun in January 2008.[3] In addition, IBM's investment in Linux (Iansiti & Richards 2006), Google's initiation of the Android platform, which has already reached second place in the mobile operating systems market,[4] or the recently announced alliance between Nokia and Intel for the development of their own OSS operating system for mobile phones named MeGoo[5] show, that even software user firms – and not software vendors only – invest in the OSS development approach.

The remarkable characteristics of OSS are rooted in a set of principles that contradicts those of proprietary software vendors, such as demanding license fees for the use of a prod-

[1] "JBoss acquired by RedHat", http://www.theserverside.com/news/thread.tss?thread_id=39866, last access: 4/4/2011

[2] "Oracle and Sleepycat", http://www.oracle.com/us/corporate/Acquisitions/sleepycat/index.html, last access: 4/4/2011, Acquisition price not published

[3] "Der nächste Deal: Sun übernimmt MySQL", http://www.computerwoche.de/nachrichtenarchiv/1852764/, last access: 4/4/2011

[4] "Android No. 2 Mobile OS: Apple Eats Its Dust", http://www.pcworld.com/article/210384/android_no_2_mobile_os_apple_eats_its_dust.html, last access 4/4/2011

[5] "Allianz der Riesen: Nokia und Intel schließen Open-Source-Bündnis", http://www.spiegel.de/netzwelt/games/0,1518,678001,00.html, last access: 4/4/2011

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uct (Andersen & Konzelmann 2008, Chen, Iyigun & Maskus 2007). Conversely, because OSS is developed by a distributed group of individual programmers interacting via electronic mailing lists rather than within the boundaries of a software vendor, it is free of charge and therefore differs from proprietary software in the way it is produced and distributed (Ghosh 2005, Kogut & Metiu 2001, Lakhani & Von Hippel 2003, Raymond 1998).

Another prominent characteristic of OSS is that the source code, written in a human readable programming language, is open to anyone and therefore enables capable users (which may be individuals or firms) to modify the code according to their own needs (Von Krogh & Spaeth 2007, Von Hippel & Von Krogh 2003). If a modification contributes to the quality of the original piece of software, such as fixing a bug or adding new functionalities, users are often willing to give the extension back to the open source software development project (OSSDP) for reputational reasons (Roberts, Hann & Slaughter 2006, Shah 2006, Xu, Jones & Shao 2009) or as a form of gift exchange (Bergquist & Ljungberg 2001). As a consequence, usually an OSSDP is surrounded by a relatively heterogeneous community consisting of developers, bug fixers, users, and, if the project is of commercial interest, firms (Dahlander & Magnusson 2005).

Recent research confirms that OSSDPs of commercial interest exist in many different ways according to their revenue model, type of license, development style, number of participating firms, number of participating volunteers, or governance mode (e.g., Bonaccorsi, Giannangeli & Rossi 2006, Dahlander & Magnusson 2008, West 2003). For example, relevant revenue models range from dual licensing approaches, where a product is offered under two licenses, one OSS license and (at least) one proprietary license, to approaches in which the revenue stream entirely is generated through the sale of complementary products or services (Alexy 2009, Fitzgerald 2006, Olson 2005). Depending on the underlying business model, firms benefit from an engagement in the development of OSS by getting access to external knowledge, by reducing costs, or by speeding up the diffusion of a technology (Ågerfalk & Fitzgerald 2008, Bonaccorsi & Rossi 2006, West & Gallagher 2006).

Building upon organizational structures found in OSSDPs allows firms to obtain resources external to the firm. This reflects a dominant view in modern innovation management research known as the open innovation paradigm (Chesbrough 2003d, Chesbrough, Vanhaverbeke & West 2006). Firms that apply an OSS approach therefore benefit from opening up their own proprietary software projects or engaging in existing OSSDPs.

Thus, if a firm is able to encourage participation of external parties, it can reduce development costs by including the external contributions that the firm would otherwise have to pay for.[6] As an OSS product is free of charge and open to anyone, it possesses characteristics of a public good such as nonexcludability and nonrivalry (Von Hippel & Von Krogh 2003, Stürmer, Spaeth & Von Krogh 2009). Therefore, it is almost impossible for those who created the value – a group of volunteers or a group of firms alike – to stop competitors from selling added value (Baldwin & Clark 2006, Dahlander 2005, Lerner & Tirole 2002). Consequently, as natural barriers and intellectual property (IP) protection systems are missing, competition is likely to shift to complementary markets (Parker & Van Alstyne 2005).

Firms acting in a closed innovation environment usually respond to competition by increasing the level of IP protection and building stronger barriers around their own innovations (Bogers 2011, Chesbrough 2003b, Chiaroni, Chiesa & Frattini 2010, MacCormack & Iansiti 2009, Pisano 1990). With OSS, this is not possible as a firm either does not own all the copyright required to build strong barriers, or, in the case in which a firm owns the entire copyright of an OSSDP, an increased IP protection would abolish the benefits of OSS, such as rapid diffusion (Morgan & Finnegan 2008). In a similar vein, based on a common understanding that only few innovations yield value on stand-alone basis, various researchers have pointed to the fact, that keeping innovation closed might not be the best path to capturing value (e.g., Chesbrough 2003b, Parker & Van Alstyne 2005, Pisano & Teece 2007, Teece 2010b).

Building upon the distinction between value creation and value capture (Chatain & Zemsky 2011, Lepak, Smith & Taylor 2007, Narayanan, Yang & Zahra 2009, West 2007), value capture becomes increasingly difficult if other entities control required elements for value creation. In other words, if a firm is willing to build a business model upon an OSSDP, due to the heterogeneous group of stakeholders (i.e., volunteers, other firms), influencing a project's trajectory is disproportionately difficult compared to software development within the boundaries of a firm.

As a consequence of decreasing license fees in the software market, OSS development approaches have become a viable alternative to proprietary approaches to software de-

[6] It is worth noting that in the case of firm-initiated OSSDPs, no community – neither user nor developer community –, usually exists from the beginning. Consequently, in some cases, the collective singular "the community" consists of only a few individuals. Getting access to thousands of valuable developers working for free by initiating an OSSDP remains an anecdotal myth (Goldman & Gabriel 2005). Rather, creating an active community in support of an OSSDP might be one of the biggest challenges for firms trying to benefit from engaging in OSS development by initiating their own projects.

velopment and distribution (Augustin 2008, Lerner & Schankerman 2010). However, although harnessing free external resources in a firm-driven software development approach potentially increases the firm's innovative performance and reduces its development costs, without appropriate governance mechanisms, the diverse views on a project's trajectory present in an OSSDP lead to divergence (Almirall & Casadesus-Masanell 2010), resulting in increased coordination and control costs or a fork in the worst case.

Therefore, as firms increasingly deploy resources into OSSDPs (Fosfuri, Giarratana & Luzzi 2008, West & O'Mahony 2008), they need to gain a better understanding of the different possible governance modes in relation to exerting control (O'Mahony 2007). The overall goal of this dissertation therefore revolves around the question of how firms influence and control OSSDPs they are dedicated to.

1.2 Research Questions and Dissertation Goal

Due to its principles that contradict those of proprietary software development, OSS as a phenomenon has attracted increasing attention to researchers and managers in recent years. There have been theoretical and empirical articles published concerning various topics in relation to using an OSS development approach, such as:

- economics of OSS (e.g., Casadesus-Masanell & Ghemawat 2006, Casadesus-Masanell & Llanes 2009, Darmon & Torre 2009, Demil & Lecocq 2006, Economides & Katsamakas 2006, Lerner & Tirole 2002, Perens 2005),
- the adoption and business value of OSS (e.g., Chengalur-Smith, Nevo & Demertzoglou 2010, Chengalur-Smith, Sidorova & Daniel 2010, Rossi Lamastra 2009, Torkar, Minoves & Garrogós 2011, Ven & Verelst 2008, Ven & De Bruyn 2011),
- the relationship between firms and OSS communities (e.g., Bonnacorsi et al. 2006, Capra, Francalanci, Merlo & Rossi Lamastra 2011, Dahlander & Magnusson 2005, Dahlander & Magnusson 2008, Henkel 2009, Krishnamurthy & Tripathi 2009),
- evolving OSS business models (e.g., Hemphill 2006, Krishnamurthy 2003, Krishnamurthy 2005, Mann 2006, Riehle 2011b, Teece 2010b),
- the motivation of individual programmers to provide their labor for free (e.g., Bitzer, Schrettl & Schröder 2007, Hars & Ou 2002, Krishnamurthy 2006, Lakhani & Wolf 2005, Stewart & Gosain 2006, Wu, Gerlach & Young 2007, Xu et al. 2009), and

- organization, structure, and hierarchy within OSS communities (e.g., Cornford, Shaikh & Ciborra 2010, Crowston & Howison 2006, De Laat 2007, Franck & Jungwirth 2003a, Hahn, Moon & Zhang 2008, Iannacci 2005, Markus 2007, O'Mahony & Ferraro 2007, Von Krogh, Spaeth & Lakhani 2003).

Although those articles, and many others alike, did a great job in helping explaining OSS principles and implications for business, they lack explanations of how firms can control the project's trajectory in relation to their interests and investments. For example, regarding the relationship between firms and communities, firms are often viewed as a coherent group with common interests and visions about an OSSDP (Dahlander & Magnusson 2005), ignoring different business models and corresponding interests and control structures those firms may apply.

By studying different motivation structures of individuals providing their service to an OSSDP for free, many researchers added to the understanding of antecedents for voluntary contributions to a public good (e.g., Bitzer et al. 2007, Wu et al. 2007). However, although researchers have discussed the role of firm-sponsored programmers and their motivation structure (e.g., Krishnamurthy 2006, Lakhani & Wolf 2005, Roberts et al. 2006), they largely neglected the existence of different business models and their coordination and control necessities built upon an OSSDP that might influence a firm-sponsored developer's motivation.

Similarly, research that outlines the importance of organizational aspects of OSS development has primarily drawn attention to structures and processes within a community, such as leadership structures, network positions, hierarchy, or core-periphery structures (e.g., Crowston & Howison 2006, Dalander & O'Mahony 2011, Fleming & Waguespack 2007, Giuri, Rullani & Torrisi 2008, Grewal, Lilien & Mallapragada 2006, Lakhani 2006, MacCormack, Baldwin & Rusnak 2010, Masmoudi, den Besten, de Loupy & Dalle 2009). Only a few have taken the presence of an individual's sponsoring by a firm and related control potentials into account.[7] In summary, despite considerable efforts in providing explanations of how OSS development works and which roles firms and their employed developers assume within OSSDPs, recent research primarily has featured an OSS centric view. However, from a firm's perspective, OSS development still is an innovation activity even though development might take place beyond firm boundaries. In this sense, firms have to manage innovation with neither having complete ownership over the product nor

[7] See Dahlander & Wallin (2006), Henkel (2009) or Stewart, Ammeter & Maruping (2006) for examples of a few exceptions.

being able to apply labor contract mechanisms for external developers. But how can a firm influence or control an OSSDP it is investing resources in?

Conversely, organizational control theory (e.g., Eisenhardt 1985, Ouchi 1979) features a firm centric view. Furthermore, the focus of organizational control theory is on internal resources such as individuals who are bounded by labor contracts. Resources external to the firm such as a community of developers are beyond the firm's area of direct influence, a situation that is not captured by classical control theory.

Thus, because there is a dearth of research applying a firm centric view to OSS development and because classical control theory (e.g., Barker 1993, Kirsch 1997, Ouchi & Johnson 1978) lacks applicable concepts, a number of questions concerning organizational control are not yet entirely answered. For example, given that firms allocate resources to an OSSDP, such as authorizing employed developers to devote their labor to the project, how are those developers advised to behave within the community? Are organizational structures of a firm mirrored within OSS communities? How does the presence of multiple firms with potentially multiple interests influence a single firm's relation to an OSSDP? And finally, does the business model influence the intensity of firm's engagement in OSS development? Thus, by taking on a firm centric view, all these questions may be subsumed under the overall research question that guides this dissertation:

> If innovation is managed at least partially outside and across the legal and organizational boundaries of the firm, how can a firm influence or even control a project its business model depends on without having discretionary power over developers external to the firm?

This dissertation seeks to answer this question in two steps. First, a theoretical basis will be provided by merging relevant research into OSS, such as the relationship between firm and community, OSS business models, community structure, and knowledge management in open innovation with research into organizational control. Building upon this basis, an extended control theory will be developed that captures the charateristics of innovation activities beyond firm boundaries and in the absence of vertical command chains, such as in the case of OSS. Second, drawing on various notions of authority, the extended control theory for managing innovation activities beyond firm boundaries will be tested in both a multi-project (Chapter 4) and a single-project (Chapter 5) scenario.

As such, this research is, to the best of my knowledge, the first that conceptually defines the different options a firm might apply for controlling OSSDPs they do not own, and, in addition, the first that provides empirical evidence for these options within and

across different projects. The contribution of this dissertation is complemented by showing avenues for further theoretical and empirical work. Finally, this dissertation may give recommendations to managers of software vendors planning to adopt the OSS approach of software development.

1.3 Anchorage in Philosophy of Science

Before I start outlining the structure of this dissertation and reporting the findings of my investigations, I briefly want to share my understanding of organization and management as well as information systems (IS) research. No one would doubt that one primary goal of a dissertation is to contribute to the creation of scientific knowledge in a specific discipline. However, prior to gaining scientific knowledge through the use of a certain method it seems suitable to rethink norms, values, and procedures that we (as researchers) take for granted.

In front of almost every discussion in or about epistemology is the claim for truth. From a radical constructivist point of view, it is still questionable if there even is an objective truth as our perception of reality is constructed in a brain that is rather isolated and independent from any input from outside (Von Glasersfeld 1995). However, given the assumption that there is a truth, how can we identify and judge what is true and what is not?

With regard to the latter question, philosophers differentiate between different concepts of truth (Frank 2006). *Correspondence theory* of truth treats a proposition as true, if it is consistent with the part of reality it describes. However, as the theory further assumes that a correspondence between a proposition and the analyzed part of the reality can be observed, it is not useful to uncover a superior truth due to the problem of biased perceptions. The *coherence theory* of truth demands testing new knowledge against accepted wisdom and *consensus theory*, which might be viewed as an extension of coherence theory, builds on human judgment by a group of elaborated scientists in order to define if a proposition is true or not. Admittedly, neither of these approaches provides a solution for situations where two different groups of scientists reach contradictory conclusions.

Thus, all abovementioned concepts of truth show deficiencies, especially due to their focus on already existing knowledge. Possibly the most famous example of continuously contributing to an existing body of scientific knowledge ignoring a superior truth is the case of Newtonian mechanics. It was not until Einstein formulated mechanisms of action in cases of speed close to light velocity that fundamentally differed from what people treated

as reality – supported by Newton's observations –, that a whole discipline had to accept that observation itself is not effectual to unrevealing *the* truth.

Driven by the incompleteness of concepts of truth, generations of philosophers turned toward investigating the process of generating knowledge. As a result, we find many different approaches to explaining the creation of scientific knowledge. These approaches or "schools", often derived from different disciplines, are considered guiding paradigms within science. In order to position the present dissertation in the philosophy of science, I will briefly sketch the most influential approaches.[8] However, as these approaches are based on basic ontological and epistemological positions,[9] further clarification is needed first. Burrel & Morgan (1979) developed a framework based on the distinction between a subjective and an objective approach to social sciences. In their work, they differentiated between four different layers, namely ontology, epistemology, human nature, and methodology, mirroring different levels of assumptions. By simultaneously considering different layers and perspectives, this work portrays the choice of a research method as a function of the initial choice of perception of reality (see Figure 1.1).

Being the extrema of a continuum, the subjective approach to social science would consider reality as an individual's mental product whereas the objective approach grasps reality as external to the individuum. Furthermore, the subjective and objective view on social science are mutually exclusive perspectives (Von Kortzfleisch 2004), meaning that they cannot simultaneously operate as a basis for the same research project.

Given the heterogeneity in philosophical approaches to social science, it has increasingly been argued that it would be theoretically unsound if different epistemological and ontological assumptions are mixed (e.g., Burrel & Morgan 1979, Chen & Hirschheim 2004, De Vaujany, Lesca, Fomin & Loebbecke 2008, Niehaves 2005). Consequently, if the combination of different epistemological perspectives is restricted by theoretical consideration within the philosophy of science (Kuhn 1962), following Burrel & Morgan (1979), the combination of multiple research methods is also restricted, something known as *method incommensurability*. For example, observation, although deeply anchored in the tradition of behavioral sciences, would not be applicable in a constructivist view of the world where a subjective approach to science was chosen.

Referring to influential schools in social science, *positivism* probably is the most widely adopted school in information systems research (Frank, Schauer & Wigand 2008, Niehaves

[8] See Frank (2006) for a detailed discussion on the applicability of different schools of thought to IS research.
[9] Ontology deals with the philosophical study of existence and reality while epistemology describes ways to get access to reality.

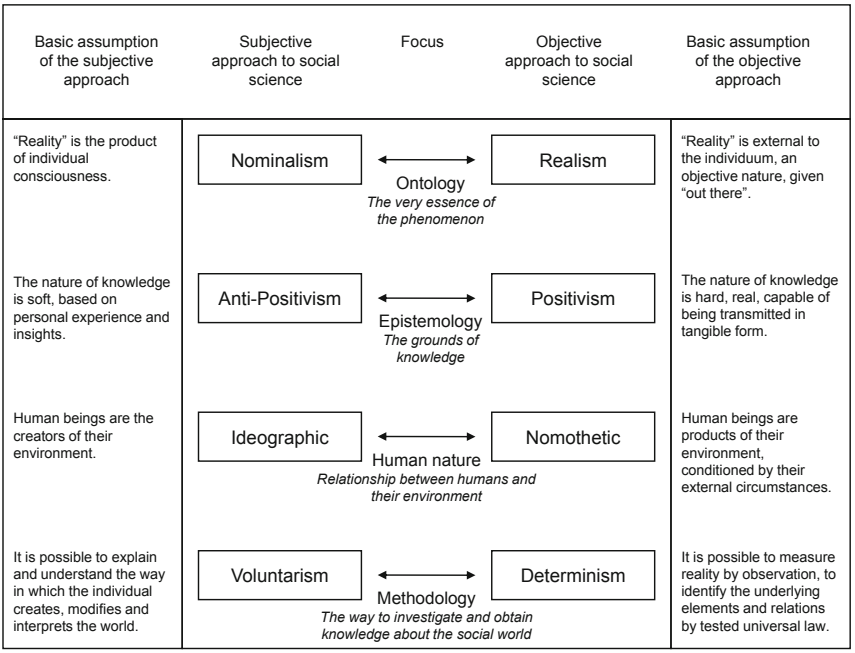

Figure 1.1 The Subjective and Objective Dimensions in Philosophy of Science (Source: Burrel & Morgan 1979, p. 9)

2005). In its broadest form, referred to as logical positivism, it is based on the assumption that scientific knowledge only can be based on empirical evidence or proven logic (e.g., Frank 2006). As the word *positive* has the additional connotation of something useful, for instance, reality in contrast to non-reality, positivism therefore is based on realism and an objective approach to reality (Störig 1968). However, in contrast to research in engineering or computer sciences, it is inherently clear that with a positivistic approach to social science, the creation of future worlds is limited, if not impossible, as positivism does not allow for scientific knowledge that is not tested against something already existent.

By denying the assumption of the logical positivism, namely excluding the existence of prior knowledge, Popper (1934) created a stream in philosophy of science known as *critical rationalism*. Depending on how Popper is interpreted, critical rationalism may be viewed as an extension of logical positivism, as it is still based on empiricism, but an empiricism that is grounded on a theoretical background that existed a priori (Settle 1979). Remembering

Humes, Popper further postulated that it is logically impossible to inductively generate theory based on single observations. With regard to positivism in its purest sense, this implies that researchers following a positivistic approach, in theory, would have to perform a complete test against reality. That is, every possible instance of reality has to be tested until results are found that lead to a rejection of the proposed theory.

Constructivism considers nature not just as given, but as an aggregation of cultural constructions (Frank 2006). Variations of constructivism, such as radical constructivism, reject a person's ability to objectively perceive reality, as any reality is the product of individual consciousness. As this leads to relatively unfeasible implications for social sciences, alleviated variations, such as the Erlangen constructivism, instead believe in the capability of resolving the problem of constructed reality by developing explicit observation and theory languages (Mir & Watson 2000, Thiel 1984).

Finally, I want to include a philosophical stream in this enumeration of approaches that has received comparatively little attention, namely *constructive empiricism*. A characteristic of this approach is that the acceptance of a theory does not include the blind belief in its universal truth (Van Fraassen 1980, Van Fraassen 2008). Instead, the constructive empiricism only accepts a theory in terms of its empirical adequacy:[10] "Science aims to give us theories which are empirically adequate; and acceptance of a theory involves as belief only that it is empirically adequate" (Van Fraassen 1980, p. 12).

The aim of this dissertation is to develop theory as well as to test this theory against reality. Regarding theory development, this dissertation applies the concept of theory in the sense of Seth & Zinkhan (1991, p. 77) who followed Hunt (1983) and Rudner (1966). They define theory as a:

> systemtiatically related set of statements, including some lawlike generalizations, that is empirically testable. The purpose of theory is to increase scientific understanding through a systematized structure capable of both explaining and predicting phenomena.

Regarding the test of theory against reality, since this dissertation uses empirical data to answer the research questions provided in the precursory section, based on the discussion above, it implicitly adopts a positivistic perspective. However, following positivism in its

[10] Based on the distinction between a syntactic and a semantic view of scientific theories, a theory is empirically adequate, if appearances are isomorphic to the empirical substructures of some model of the theory. In other words, the theory is empirically adequate if the observable phenomena can "find a home" within the structures described by the theory. (cf. Stanford Encyclopedia of Philosophy, http://plato.stanford.edu/entries/constructive-empiricism/#1.5, last access: 11/5/2011).

purest sense would imply to deny the acceptance of other contradictory theories (Bird 2003, Spencer 1987). To allow the theory that has to be developed to exist conjointly with other potenially conflicting theories, this dissertation aims to stay coherent with the constructive empiricism provided by Van Fraassen (1980) – although anti-realistic – in that the acceptance of a theory is based on its empirical adequacy only.

1.4 Positioning of the Dissertation

The phenomenon of firms engaging in the development of OSS may be viewed from different perspectives, such as economics, management, law, or information systems (Brügge, Harhoff, Picot, Creighton, Fiedler & Henkel 2004). Consequently, this dissertation is influenced by a variety of disciplines, but may be mainly classified as a contribution to organization and management science as well as to information systems research. Each of these disciplines, in turn, consists of a number of different approaches and methods. Whereas information systems research as understood in North America shows no significant difference from management and organization research (Chatterjee 2001), within European information systems research, multiple approaches are applied (Frank et al. 2008). Therefore, in order to ligitimize the choice of the methods used in this dissertation, I will discuss briefly where this dissertation is positioned within information systems research and organization and management science.

Information systems research is claimed to be multidisciplinary as business administration, information science, sociology, and psychology contribute to studying the development, implementation, and usage of information systems and information technology inside organizations (Cecez-Kecmanovic 2011, Chen & Hirschheim 2004, Niehaves 2005, Orlikowski & Baroudi 1991, Wade & Hulland 2004, Winter 2008). Furthermore, as discussed, different schools of thought, especially if embedded in different disciplines, imply the use of different methods. For example, whereas behaviorism, which is grounded on positivism (Danziger 1979), is the dominating paradigm in North American information systems research and turned toward empirical investigations with the aim of describing the nature of reality (Baskerville & Myers 2002, Frank et al. 2008), design science, an alternative approach to information systems research, "creates and evaluates IT artifacts intended to solve identified organizational problems" (Hevner, March, Park & Ram 2004, p. 77).

One of the main differences between behaviorism on the one side and design science on the other, is that the latter generates new knowledge mainly through interpretative logic

that results in hermeneutic models or artifacts (March & Smith 1995, Nunamaker, Chen & Purdin 2004, Van Aken 2004). In contrast, driven by empirical results, behaviorists seek to explain reality based on observations (Danziger 1979). However, both paradigms show deficiencies. Whereas design science has difficulties finding theoretical justifications due to its orientation to construction (Baskerville, Lyytinen, Sambamurthy & Straub 2010), behaviorism is blamed for its intense, and sometimes unreflected, use of empirical methods (Baron 2010, McCloskey 1985b, McCloskey & Ziliak 1996, Straub, Boudreau & Gefen 2004) and a "neurotic behavior [...] such as its compulsive handwashing in statistical procedures" (McCloskey 1985a, p. 18).

Consequently, a combination of these approaches therefore would simultaneously benefit from observations represented by empirical results and initiating and creating phenomena that otherwise are difficult to find in reality.[11] Recently, European scholars especially therefore called for an increased use of design-oriented research in information systems in order to complement the process of creating scientific knowledge (Baskerville et al. 2010, Österle et al. 2010). In addition, design-oriented research is increasingly requested even for organization studies (Romme 2003, Von Krogh 2010).

However, although information systems as a discipline, would benefit from methodological pluralism, in order to answer a *single* research question or to close a *single* research gap, using multiple methodologies would be incommensurable and contradict the claim for methodological fit (Edmondson & McManus 2007). Consequently, using multiple methodologies[12] within one dissertation ought to be abandoned. Therefore, aligning the proposed research questions discussed in Section 1.2 with an appropriate methodology is mandatory. As answering the research questions will require observing behavior, in this case behavior of individuals and firms, following a behavioral approach to science is necessary. Thus, this dissertation is based on an understanding of information systems research in a behavioral sense and therefore equally may contribute to management and organization science.

[11] It is important to note that while behaviorism is driven by the search for a universal truth within existing realities, design science aims to create realities. However, although design science aims to creation (of artefacts), it not necessarily requires a constructivistic view on reality.

[12] Note: Whereas *methodology* may be interpreted as the theory of methods, *method* refers to systematically giving details of procedures used. Therefore, refaining from using methodological pluralism does not prohibit the use of multiple methods.