1. Introduction

In recent years, development of information systems (IS) has rapidly changed towards increasing division of labor between firms (Dibbern 2009). Two trends are emerging. First, client companies faced with cost pressure and scarcity of skilled personnel, increasingly outsource software development to external service providers (Dibbern 2009). Second, the formerly oligopolistic enterprise application software industry has started to disintegrate into focal partnership networks – so called platform ecosystems (e.g. Messerschmitt et al. 2003; Tiwana et al. 2010) – with two types of corporate actors; huge platform vendors offer generic software platforms (Kude et al. 2012; Tiwana et al. 2010) while small independent complementors use this platform to build add-on software systems (Baldwin et al. 2000; Jarillo 1988; Lee et al. 2012; Prencipe 2003; Sztompka 2000; Tiwana et al. 2010).

Despite the increasing prominence of IS outsourcing and platform ecosystems, many of these inter-organizational partnerships fail to achieve expected benefits (Ceccagnoli et al. 2012; Lacity et al. 2009). For instance, client companies engaged in outsourcing projects may suffer from low service quality or unexpected costs (Dibbern et al. 2008; Lacity et al. 2009), and complementor companies may go bankrupt when a powerful platform vendor replicates or invents around key features of their products (Ceccagnoli et al. 2012; Kude et al. 2012). Ineffective governance and control frequently plays a pivotal role in producing these failures, therefore the overarching objective of this dissertation is to better understand how governance and control of inter-organizational software development can be improved.

1.1. Governance and Control of Inter-Organizational Software Development

The criticality of governance and control for the success of inter-organizational software development is now well recognized (Dibbern et al. 2008; Goles et al. 2005; Lacity et al. 2009; Lee et al. 2006; Rustagi et al. 2008; Sarker et al. 2012). Typically, informal relational governance mechanisms and formal contractual governance mechanisms are used in combination in the form of a portfolio (c.f., Kirsch 1997; Kirsch et al. 2002). As an example, the client and the vendor in an outsourcing relationship contractually agree to follow formal processes and additionally rely on trust-based spontaneous cooperation (Tiwana 2010). Likewise, complementors in a platform ecosystem follow formal development guidelines defined by the platform vendor, and additionally seek informal con-

tacts with key platform vendor personnel in order to acquire valuable information (Kude et al. 2012).

Prior research on governance and control of IS development projects was mainly concerned with the explanation of the composition of the governance and control portfolio (Kirsch 1997; Kirsch et al. 2010; Maurer et al. 2012; Rustagi et al. 2008; Tiwana 2008; Tiwana 2010; Tiwana et al. 2009). Those studies typically took a static perspective by investigating the relationship between antecedents of governance and control and the consequent portfolio composition at a single point in time. While those studies provided valuable knowledge about how governance and control should be designed at a certain point in time, their static character casts doubts about the transferability of their findings to the context of complex and business-critical development endeavors that exhibit additional dynamics and uncertainty (Rustagi et al. 2008; Tiwana 2010). Such endeavors are more difficult to manage since their dynamic nature requires governance and control to evolve over time (Cardinal et al. 2004; Choudhury et al. 2003; Gregory forthcoming; Kirsch 2004; Sabherwal 2003). In this dissertation, evolutionary dynamics of governance and control in complex, uncertain, and business-critical IS development endeavors will be investigated in two empirical contexts – IS outsourcing and platform ecosystems.

1.2. Three Studies on Dynamics of Governance and Control of Inter-Organizational IS Development

There is initial evidence that evolutionary dynamics play a key role in the process of designing adequate governance and control mechanisms. In particular, prior research argued that governance and control mechanisms need to be adapted over time in response to contextual changes (Choudhury et al. 2003; Heiskanen et al. 2008; Kirsch 2004; Sabherwal 2003). While those studies revealed highly important knowledge on the dynamics of governance and control, they one-sidedly focused on rather disruptive changes that are driven by the externally given context. This is in stark contrast to the complexity of modern evolutionary theory which holds that change is not determined by the context but driven by the complex interplay of a number of sources of change (Thompson 1982; Thompson 1994). This thesis follows the central assumption that research on dynamics of governance and control in inter-organizational IS arrangements might benefit from these insights. Therefore, each of the three research projects that together form this dissertation borrows basic ideas from modern evolutionary theory and exploits those basic ideas to advance current understanding of three immediate problems that are of practical and theoretical importance. In particular, study 1 enters the controversial debate on the complementary or substitutional relationship between contractual and relational governance (e.g.

Goo et al. 2009; Poppo et al. 2002; Puranam et al. 2009; Tiwana 2010) by investigating how and why complementarity and substitution form over time. Study 2 addresses the problem that even extensively controlled outsourced IS development projects often fail to achieve desired objectives (Tiwana et al. 2009) by contrasting the design process of formal controls between successful and unsuccessful development projects. Finally, study 3 asks how small complementor companies can come to trust platform vendors and as a consequence realize the positive outcomes of trust, in face of the unique trust-building challenges of platform ecosystems.

While it is believed that modern evolutionary thinking has much to offer for the social sciences (cp. Dietz et al. 1990; Dunbar 2007), the valid critique on importing biological concepts into the social sciences should also be recognized (e.g. Prindle 2012). For that reason, each of the three research projects of this dissertation firmly grounds the ideas that were originally borrowed from evolutionary theory, in well-accepted theories from the social sciences to explain phenomena of inter-organizational governance and control that are as yet not well understood.

Each of the three research projects that together form this dissertation will subsequently be introduced in detail along with the associated research gaps, research questions, and the basic ideas borrowed from modern evolutionary theory.

1.2.1. Evolution Towards Complementarity and Substitution of Contractual and Relational Governance in IS Outsourcing

> "… a pair of interacting species… might coevolve to be so complementary that they literally cannot survive without each other." (Thompson 2010, p. 11)

Early research on IS outsourcing governance has investigated the impact of particular governance mechanisms on IS outsourcing success. One research stream identified *relational governance* as a key driver for IS outsourcing success (Goles et al. 2005; Kern et al. 2000; Lee et al. 1999); another argued that the characteristics of the IS outsourcing contract *(contractual governance)* are major determinants of success (e.g., Gopal et al. 2008). Today, it is well accepted that both contractual and relational governance are vital for successful information systems (IS) outsourcing (Grover et al. 1996; Lee et al. 2004; Sabherwal 1999). This has raised the question of how formal contractual governance and informal relational governance relate to each other.

Two conflicting views on their relationship have arisen: substitution and complementarity. The complementarity perspective argues that both types of governance have their unique strengths and therefore more of "the one" increases the benefits of the other

(Adler et al. 1996; Goo et al. 2009; Poppo et al. 2002; Sydow et al. 2003). In contrast, the substitutional perspective holds that pursuing "the one" reduces the need for the other, or even destroys the benefits of the other.

The debate on the relationship between contractual and relational governance was fueled by empirical results that showed a "bewildering array of possible relationships" (Puranam et al. 2009). Some studies found exclusive support for the substitutional view (Larson 1992; Van de Ven et al. 1995), others for the complementary view (e.g. Chua et al. 2012; Poppo et al. 2002). More recent studies drew a more fine-grained picture by showing that some forms of contractual governance (e.g., certain contract characteristics) act as substitutes to relational governance, while others act as complements (Goo et al. 2009; Tiwana 2010). Since prior research has conceptualized complementarity and substitution as logically isolated polarities that mutually exclude each other (Lewis 2000), these contradictory results appear paradoxical. Therefore, the first study of my dissertation aims to close the following research gap.

Research Gap 1: *Conceptually, prior research has parsed the relationship between contractual governance and relational governance into polarized complements vs. substitutes dichotomy. However, in reality complementarity and substitution co-exist indicating a gap in the current theoretical and empirical understanding.*

To address this gap, study 2 borrows the idea that processes of co-evolutionary interactions explain how two species become complements from modern evolutionary theory (Thompson 1982; Thompson 2010). Current evolutionary thinking holds that complementarity between two species is the outcome of preceding co-evolutionary interactions between those species (Gould 1984; Mayr 2002; Thompson 1982; Thompson 1994). For instance, the complementary relationship between a gut symbiont and its plant-eating host is the consequence of their mutual beneficial interaction over longer periods of time - the gut symbiont safely lives in the host's gut and in turn helps the host to digests plants which are more difficult to digest than meat (Thompson 1982; Thompson 1994). The long-term consequences of such an interaction are that the two species specialize to one another (Thompson 1982; Thompson 1994) to the degree that one literally cannot live without the other (Thompson 2010), i.e. the two species have co-evolved to become complements.. This basic idea is transferred to the governance context: Contractual and relational governance may become complements because they benefit from each other in interaction processes. Consequently, study 1 investigates interaction processes between contractual and relational governance over time, and assesses whether those interactions

makes contractual and relational governance to become complements or substitutes. This is achieved by answering the following research question:

RQ1: *How and why do complementarity and substitution form over time?*

Answers to research question 1 will for the first time unravel the processes through which complementarity and substitution form. The expected value of the consequent advanced theoretical understanding is that the seemingly paradoxical co-existence of complementarity and substitution in reality may be explained and contradictory results of prior research resolved. Moreover, managers will receive meaningful guidance on how they can purposefully make use of the causal mechanisms that create complementarity and substitution to design better governance mechanisms.

1.2.2. Evolution Towards Control Specificity and Success or Failure to Achieve High-Level Project Goals

> "The coevolutionary process… produces some degree of specialization.." (Thompson 1994, p.VII)

Control in IS outsourcing relationships is purposefully conducted to achieve desired high-level project goals in terms of cost, time and functionality (Banker et al. 1992; Kirsch 1996). However, even extensively controlled IS outsourcing projects often fail to achieve these goals (Abdel-Hamid et al. 1993; Keil et al. 2000; Mayr 2002; Tiwana et al. 2009). The reason for this failure to achieve the desired objectives may be rooted in the unique difficulties managers are faced with, when designing controls in an outsourcing setting. In IS outsourcing the design of effective formal controls is both more difficult and more crucial compared to internal IS projects. It is more difficult, as the complex, dynamic and uncertain nature of IS outsourcing projects (Rustagi et al., 2008) makes it difficult to translate high-level project goals into more specific formalized outcomes and behaviors *at the outset of a project*. However, such specific outcomes and behaviors that are tangibly measurable during the project are the basis of effective formal control (Kirsch 1997; Tiwana et al. 2009). From a managerial perspective, those difficulties are problematic since in IS outsourcing projects formal controls are also more crucial due to regulatory standards like the Sarbanes-Oxley act that force client companies to heavily rely on formal control (Dunbar et al. 2001; Knolmayer 2007).

Given that formal controls are both more crucial and more difficult to design at the outset of IS outsourcing projects, it can be safely assumed that high-level project goals are incrementally translated into more specific, tangibly measurable outcomes and behaviors.

Thus, the translation process from high-level project goals into more specific, tangibly measurable outcomes and behaviors seems essential for a better understanding of how and why IS outsourcing projects succeed or fail to achieve their desired objectives. Yet, prior research has not explicitly investigated this translation process. Therefore, the second study of my dissertation aims to close the following research gap:

Research Gap 2: *Prior research on control has neither offered a theoretical nor an empirically grounded explanation for how high-level project goals are translated into more specific, tangibly measurable outcomes and behaviors, and how the subsequent exercise of the emerging more specific controls relates to the success or failure to achieve high-level project goals.*

To address this gap, study 2 also builds on the notion of co-evolutionary interactions from modern evolutionary theory, but it investigates another consequence of those interactions, namely, the formation of specialization. Current evolutionary thinking holds that the incremental evolution of species towards a higher degree of specialization is mainly the result of reciprocal interactions between species and their environment[1]. For instance, bees and flowers interact with each other reciprocally – bees feed on the flower's nectar, and in turn facilitate pollination of the flower. Over longer periods of time, this interaction makes bees and flowers more specialized to one another, i.e. bees and their environment co-evolve towards higher specialization (Thompson 1982; Thompson 1994). Study 2 borrows the idea that co-evolutionary interactions between species and the environment explain how those species become more specialized (Thompson 1982; Thompson 2010). While prior research has focused on the deterministic influence of major context changes on the evolution of formal and informal controls (e.g. Heiskanen et al. 2008; Kirsch 2004; Sabherwal 2003), study 2 goes beyond those studies by investigating reciprocal interactions between controls and the context as a potential driving force for the emergence of controls with more specific, tangibly measurable outcomes and behaviors. Thus, study 2 investigates how high-level project goals are deliberately specified in a translation process that is characterized by reciprocal interactions between controls and the context. This is done by answering the following research question:

RQ2: *How are high-level project goals translated into more specific outcomes and behaviors, and how does this translation process relate to the achievement of those goals*?

[1] Please note that the „environment" of a species may consist of biotic elements like plants or animals, and abiotic elements like climate or soil (Thompson 1982; Thompson 1994).

Answers to research question 2 will help managers in IS outsourcing relationships to better cope with the unique managerial challenges that complex and dynamic IS projects imposes upon them. In particular, managers will receive meaningful guidance as to how they can consciously utilize interactions between controls and the context to design formal controls that effectively direct behavior towards the realization of high-level project goals.

While study 1 and study 2 were heavily concerned with the idiosyncrasies of governing and controlling IS outsourcing projects, study 3 pays special attention to the idiosyncrasies of governance and control in platform ecosystems. In particular, study 3 is concerned with the specific trust-building challenges in platform ecosystems of the enterprise software industry.

1.2.3. Evolution of Trust in Platform Ecosystems of the Enterprise Software Industry

> …neo-Darwinian theory views organisms as infinitely sensitive and responsive to their environments (Prothero et al. 2012, p. 1)

In platform ecosystems, particular large platform vendors (such as Apple, IBM or SAP) (Iansiti et al. 2004; Jarillo 1988), partner with a large number of small complementor organizations to jointly create value in inter-firm networks (Kude et al. 2012; Sarker et al. 2012). Platform ecosystems of the software industry differ from traditional focal inter-firm networks in several respects (Farrell et al. 1998; Hannan et al. 1977; Pathak et al. 2007). First, the participants of platform ecosystems are not linked by capital (like joint ventures) or joint effort in a specific project or business area (like strategic alliances), instead, they are linked through general agreements such as certification of software solutions and standardized partnership contracts (Kude et al. 2012; Vitharana 2003). Second, platform vendor and complementor in the enterprise software industry are not in a traditional buyer-supplier relationship, instead, they both autonomously develop and market software, and may therefore compete for the same customers (Kude et al. 2012). Third, platform ecosystems of the enterprise software industry have reached unprecedented scale such that one platform vendor partners with hundreds or even thousands of complementors (Iyer et al. 2006; Tiwana et al. 2010).

These differences from traditional focal inter-firm networks impose partners in platform ecosystems with unique managerial challenges. In particular, complementors are more unilaterally dependent from the platform vendor, and consequently more vulnerable to potential opportunistic behavior on part of the platform vendor compared to companies in

traditional focal inter-firm networks (Ceccagnoli et al. 2012; Huang et al. 2013; Kude et al. 2012). Complementors are therefore in need of trust (Möllering 2006). This need for trust is additionally underscored by the fact that trust in inter-organizational relationships enables a number of desirable relational and economic outcomes such as collaborative behavior or lower transaction cost (Carson et al. 2003; Dyer et al. 2003; McEvily et al. 2003; Nooteboom et al. 1997; Zaheer et al. 2006; Zaheer et al. 1998). However, platform vendors need to efficiently coordinate the whole network of complementors, therefore platform vendors prefer to limit inter-personal interactions by channelizing communication between the platform vendor and complementor via partnership managers that act as boundary spanners. This makes the development of trust based on repeated personal interaction difficult. Thus, in platform ecosystems of the enterprise software industry, trust is both more needed and more difficult to achieve.

However, in situations where the development of trust via repeated inter-personal interaction is not a favorable option, trust may be derived from the validity and correctness of abstract principles (Bachmann et al. 2011; Möllering 2006; Zucker 1986), i.e. institutions become an object and source of trust. In platform ecosystems, those institutions are built by the focal platform vendor that defines the macro-level rules for the ecosystem (Sarker et al. 2012; Sydow et al. 2003). This gives platform vendors the opportunity to actively create an environment in which trusted relationships, despite the unfavorable conditions, may evolve. From a theoretical point of view the conduciveness of network institutions to foster the development of institution-based trust, depends on the characteristics of an institutional system (Deakin et al. 1997; Lane et al. 1996), as well as on how boundary spanners represent these institutionalized abstract principles (Sydow 2006; Sydow et al. 1998; Sydow et al. 2003). However, prior research has neither investigated the interplay between trust-fostering institutional characteristics and how boundary spanners refer to them, nor how institution-based trust is linked to the positive economic and relational outcomes of trust. Accordingly, the third study of my dissertation aims to close the following research gap:

Research Gap 3: *Neither the distinct properties that make network institutions in platform ecosystems a source of trust nor their interplay with the actions of boundary spanners for the realization of positive trust outcomes are understood.*

To address this gap, study 3 builds on a classic yet still central principle of evolutionary theory, i.e. the environment shapes the direction of evolution (Mayr 2002; Thompson 1994). For instance, if a local environment changes such that smaller organisms are at an advantage, then the environment favors those individuals that are randomly smaller. Over

longer periods of time this environmental force will shape the direction of the population of organisms to become smaller (Gould 1984).

Study 3 harnesses this principle to advance current understanding of how the unique trust-building challenges in platform ecosystems of the enterprise software industry are overcome. In such platform ecosystems, dominant platform vendors autonomously design network institutions by formally defining the rules and values for their network (Sarker et al. 2012; Schaubroeck et al. 2012; Schein 1992). Those macro-level regulations form the environment in which each specific partnership between platform vendor and complementor is embedded. Depending on whether or not those macro-level regulations of the network are designed in such a way that the specific trust-building challenges of platform ecosystems are addressed, they may either foster or exacerbate the evolution of trust (and its associated outcomes). Hence, the macro-level regulations defined by the platform vendor may shape the evolutionary direction of trust in a platform ecosystem. These suppositions will be substantiated by answering the following research question:

RQ3: *How can the specific trust-building challenges within platform ecosystems be overcome such that direct economic and intermediate relational outcomes of trust are realized? And what is the role of network institutions and boundary spanners in those trust-building processes?*

Answers to research question 3 will help to solve the theoretical puzzle of how trust and its related positive outcomes develop within platform ecosystems despite the lack of extensive personal interaction. Based on this, managers from platform vendors will learn how they can reconcile the contradictory demands of efficiently managing a network with thousands of companies, while addressing the needs of small complementor companies at the same time.

1.3. Overview of the Dissertation

This dissertation is structured along the three research gaps and questions identified above. Altogether, three separate research studies were conducted. The studies have in common that each of them was inspired by particular aspects of modern evolutionary theory and accordingly seeks to contribute to a better understanding of the dynamics of governance and control of inter-organizational software development. They either seek to find out how contractual and relational governance become complements (study 1), how the translation process from high-level project goals into more specific, tangibly measurable outcomes and behaviors relates to the success or failure to achieve high-level project goals (study 2), and how platform vendors address the unique trust-building challenges in platform ecosystems to achieve positive trust outcomes (study 3). The dissertation is organized as follows: After this introduction, the three research projects are presented, before their cumulative findings and implications are summarized in chapter 5. Please see Table 1 for an overview of each study.

Following this first introductory chapter, the second chapter comprises of study 1. This study builds on Lewis's strategies for studying paradox (Lewis 2000) to refine the current empirical and theoretical understanding of complementarity and substitution. In particular, a multi-dimensional conceptualization of contractual and relational governance is developed that integrates multiple conceptualizations of contractual and relational governance that have been used inconsistently by prior research. Moreover, in order to explicitly recognize the role of time in the relationship between contractual and relational governance, we use process theory to develop a dynamic understanding of complementarity and substitution (Poole et al. 2004). This dynamic understanding enables us to empirically study the formation of complementarity and substitution in four IS outsourcing cases. The results of this study unveil that complementarity and substitution form in four distinct governance adaptation processes in which contractual and relational governance interact. Most importantly, our findings show that the relationship between contractual and relational governance changes over time. These changes are mainly triggered by distinct contextual events, but also, as an important exception, by preceding complementarity.

Study 2 is largely based on control theory and IS project escalation literature. Those bodies of knowledge are used to develop the notions of *interactions between controls and the context* and *formal control specificity*. The concept of control-context-interactions is used to describe the translation process of high-level project goals into tangibly measurable outcomes and behaviors, while the concept of formal control specificity is used to capture