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Risk, Governance, and Performance in Information Systems Projects

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Abstract

Motivation: Failure of information systems (IS) projects may have serious consequences for private business organizations and public administrations, including cost escalations, delays in processes and decisions, and complete business standstill. Over the last decades, a large body of research has developed to identify reasons for IS project failures (risks) and management strategies (governance mechanisms) to increase IS project performance. However, failure rates for IS projects reported in recent industry and research studies are still high. In this thesis, it is argued that our understanding of risks and governance mechanisms in IS projects is still limited because of four research challenges (RC) that are not sufficiently addressed in prior research: (RC1) weak empirical basis, (RC2) overgeneralization, (RC3) unclear theoretical basis, and (RC4) fragmentation.

Purpose and research approach: In addressing these research challenges, the objective of this thesis is to increase the understanding of how IS projects should be managed in order to increase IS project performance. To address RC1, meta-analytic techniques are employed to aggregate empirical results reported in extant IS project literature. RC2 is addressed by investigating differences between internal and outsourced IS projects, between client and vendor perspectives on outsourced IS projects, and between emerging and mature phases of the information technology outsourcing (ITO) industry. With regard to RC3, the theoretical lenses of transaction cost economics (TCE) and control theory are examined. To deal with RC4, this thesis classifies risks and governance mechanisms into a comprehensive framework and compares their effects on IS project performance. To do so, two methodological approaches are employed. First, a risk management data set of a major IS vendor is analyzed using regression analysis techniques. Second, the existing body of IS project research is aggregated and reinterpreted using meta-analytic techniques.

Results: This thesis offers several empirical findings. First, an analysis of the effects of transaction characteristics on vendor risk estimation in outsourced IS projects shows that larger projects and fixed price contracts are significantly associated with higher vendor risk estimations. On the other hand, strategic importance and client familiarity are not associated with vendor risk estimations. Furthermore, an additional efficiency test suggests that the vendor's estimation of IS project risk is efficient with regard to project size and contract type, and predicts project profitability. Second, an analysis of the relationship between task uncertainty and contract type choice shows that task uncertainty does significantly predict contract type choice in the emerging phase of the ITO industry, but not in the current mature phase. Third, an analysis of the effects of control modes on IS project performance shows that behavior control has a positive effect on IS project performance only in hierarchical control relationships, whereas self-control has a positive effect on IS project performance only in market-based control relationships. Outcome control and clan control have a positive effect on IS project performance in both forms of control relationships. Fourth, an investigation of the most frequently studied determinants of IS project performance results in a framework of 22 determinants classified into six categories. Comparing their relative effect sizes reveals that governance mechanisms have stronger effects on IS project performance than characteristics of the project environment. Within the governance mechanisms, relational processes have higher effects than formal processes. Within the characteristics, team and user characteristics have higher effects than project and task characteristics.

Contributions: This thesis contributes to research in several ways. First, by complementing the predominant client's perspective on IS project risk with the perspective of the vendor. Second, by developing and empirically testing an explanation for the mixed results in ITO research when TCE is used as analytical framework. Third, by theoretically separating and empirically testing the effects of control on IS project performance in hierarchical and market-based control relationships. Fourth, by classifying the most frequently studied determinants of IS project performance and empirically comparing their relative effect strengths. For practice, this thesis provides guidelines for project managers on how to manage IS projects to increase IS project performance, and guidelines for clients of outsourced IS projects on how to manage the outsourcing relationship with the vendor.

Limitations: This thesis is subject to several limitations that have to be mentioned. First of all, although this thesis gives a relatively broad overview of IS project research, it focuses on specific risks and governance mechanisms in the more detailed empirical analyses. Hence, generalizability of the findings may be limited. Additionally, the empirical analyses are based on non-experimental data. Hence, the findings of this thesis are potentially exposed to internal validity threats. Furthermore, each empirical analysis included in this thesis is subject to specific validity threats such as construct validity or statistical conclusion validity.

Future research: Based on its findings and limitations, this thesis identifies several avenues for future research. These include the benefits of IS project risk management, interaction effects between IS project risks, transmission of control portfolios through mixed market-based/hierarchical control chains, integrated explanatory models of IS project success, and the development of an "endogenous" ITO theory.

Keywords: information systems project, risk, governance, outsourcing, contract type, control theory, industry maturity, project performance, transaction cost economics, vendor perspective

Table of contents

List of figures

List of tables

List of abbreviations

A	Assumption
ACM	Association for Computing Machinery
AISeL	Association for Information Systems Electronic Library
AMCIS	Americas Conference on Information Systems
AMJ	Academy of Management Journal
ANOVA	Analysis of variance
AOM	Academy of Management
BLUE	Best linear unbiased estimator
CA	Category
CON	Conference
CP	Capped price
d.f.	Degrees of freedom
DFG	German Research Foundation
ECIS	European Conference on Information Systems
ERP	Enterprise resource planning
FP	Fixed price (in Sections 5 and 6)
FP	Formal processes (in Section 8)
H	Hypothesis
HICSS	Hawaii International Conferences on System Sciences
ICIS	International Conference on Information Systems
IEEE	Institute of Electrical and Electronics Engineers
IS	Information systems
ISR	Information Systems Research
IT	Information technology
ITO	Information technology outsourcing
JMIS	Journal of Management Information Systems
JSTOR	Journal STORage
MA	Meta-analysis
MISQ	Management Information Systems Quarterly
MS	Management Science
OCIS	Organizational Communication and Information Systems
OLM	Ordinary linear model
OLS	Ordinary least squares
P	Property

PC	Project characteristics
R	Rank
RBV	Resource-based view
RC	Research challenge (in Section 1)
RC	User/IS team relationship characteristics (in Section 8)
RFP	Request for proposal
RP	Relational processes
RQ	Research question
RS	Research stream
S	Study
SD	Standard deviation
SMJ	Strategic Management Journal
SSR	Sum of squared residuals
SSRN	Social Science Research Network
TC	IS team characteristics
TCE	Transaction cost economics
TEU	Task environmental uncertainty
TM	Time and materials
UC	User characteristics
VHB	German Academic Association for Business Research
VIF	Variance inflation factor

List of symbols

$\%V$	Percentage of variance that is accounted for by statistical artifacts
a_l	Attenuation factor to correct effect size *l* for measurement error
$\hat{\beta}_j$	OLS estimate of the *j*th parameter
$\widehat{ß}$	Vector of OLS estimates
b_j	Hypothetical value for the *j*th parameter
β_j	*j*th parameter
ß	Vector of parameters
b	Vector of hypothetical values for the parameters
$CI_{\bar{\rho};.95}$	95 percent confidence interval around the expected rho
$CR_{\bar{\rho};.80}$	80 percent credibility interval around the expected rho
e_l	Error of effect size *l*
ε_i	Residual of the *i*th linear OLS equation
e	Vector of residuals
ϵ	Error term
I	Identity matrix
i	Individual project index
j	Independent variable / parameter index
k	Number of effect sizes
l	Individual effect size index
m	Number of independent variables / parameters
n_l	Sample size of effect size l
N	Total sample size
n	Sample size
$\mathcal{N}$	Normal distribution
o	Subsample index
$\bar{\rho}_o$	Weighted average of corrected effect sizes (average rho) within subsample o
$\bar{\rho}$	Weighted average of corrected effect sizes (average rho)
$Q_{between}$	Cochran's (1954) chi-square statistic for heterogeneity that is explained by partitioning into subsamples
Q_o	Cochran's (1954) chi-square statistic for heterogeneity within subsample o
Q_{within}	Cochran's (1954) chi-square statistic for heterogeneity within all subsamples
Q	Cochran's (1954) chi-square statistic for heterogeneity
$\overline{r_{corrected}}$	Weighted average of corrected effect sizes (average rho; $\bar{\rho}$)
$\bar{r}$	Sample-size-weighted average of uncorrected effect sizes

r_l	Uncorrected effect size *l*
$r_{l;corrected}$	Effect size *l* corrected for measurement error (corrected effect size *l*)
$r_{l;xx}$	Independent variable measurement error of effect size *l*
$r_{l;yy}$	Dependent variable measurement error of effect size *l*
R^2	Coefficient of determination
SD_r	Standard deviation of corrected effect sizes
SD_ρ	Standard deviation of rho
$SE_{\bar{\rho}}$	Standard errror of rho
$SD(r_{corrected})$	Standard deviation of corrected effect sizes
$SD(\rho)$	Standard deviation of rho
$SE(\bar{\rho})$	Standard errror of rho
$\overline{Var(e)_{corrected}}$	Average of corrected sampling variances
$Var(e_l)_{corrected}$	Sampling variance of effect size *l* corrected for measurement error
$Var(e_l)$	Sampling variance of effect size *l*
$Var(r_{corrected})$	Variance of corrected effect sizes
$Var(\rho)$	Variance of corrected effect sizes corrected for sampling variance (variance of rho)
ω_l	Weight of effect size *l*
W	Sum of weights across effect sizes
X_j	*j*th independent variable
σ_e^2	Variance of the residuals
x_{ji}	*i*th observation for the *j*th independent variable
$\mathbf{X}$	Matrix of observations of the independent variables
y_i	*i*th observation for the dependent variable
$\mathbf{y}$	Vector of observations for the dependent variable
Y	Dependent variable
Z	Two-sample Z-statistic

A Introduction to the thesis's publications

1 Introduction

1.1 Motivation

Information systems (IS) projects are an integral part of modern business organizations and public administrations (Aladwani, 2002c; C. E. Koh & Prybutok, 2003). Most modern businesses and administrations depend strongly on operational, tactical, and strategic information to carry out their processes, and make plans and decisions (Jasperson, Carter, & Zmud, 2005). Therefore, necessary information is gathered, transformed, and presented in information systems (Lyytinen & King, 2006). These information systems are developed in projects (J. J. Jiang, Klein, & Shepherd, 2001). These IS projects usually comprise IS development tasks, including requirements analysis, system design, implementation, and test as well as post-development tasks, including system integration and organizational change management (Banker & Slaughter, 2000; Zmud, 1984). Failure of IS projects can have serious consequences for businesses and administrations (McFarlan, 1981). On the one hand, budget overruns in IS projects might seriously harm the cost performance of businesses and administrations (Calisir & Gumussoy, 2005). More importantly, on the other hand, IS projects that fail to deliver IS in time and with the specified functionality might have far-reaching consequences from delays in operational processes and strategic decisions to a complete business standstill (Lyytinen & Robey, 1999).

As a consequence, a large body of empirical research on IS projects has emerged. This body of empirical literature can be partitioned into three research streams (RS).

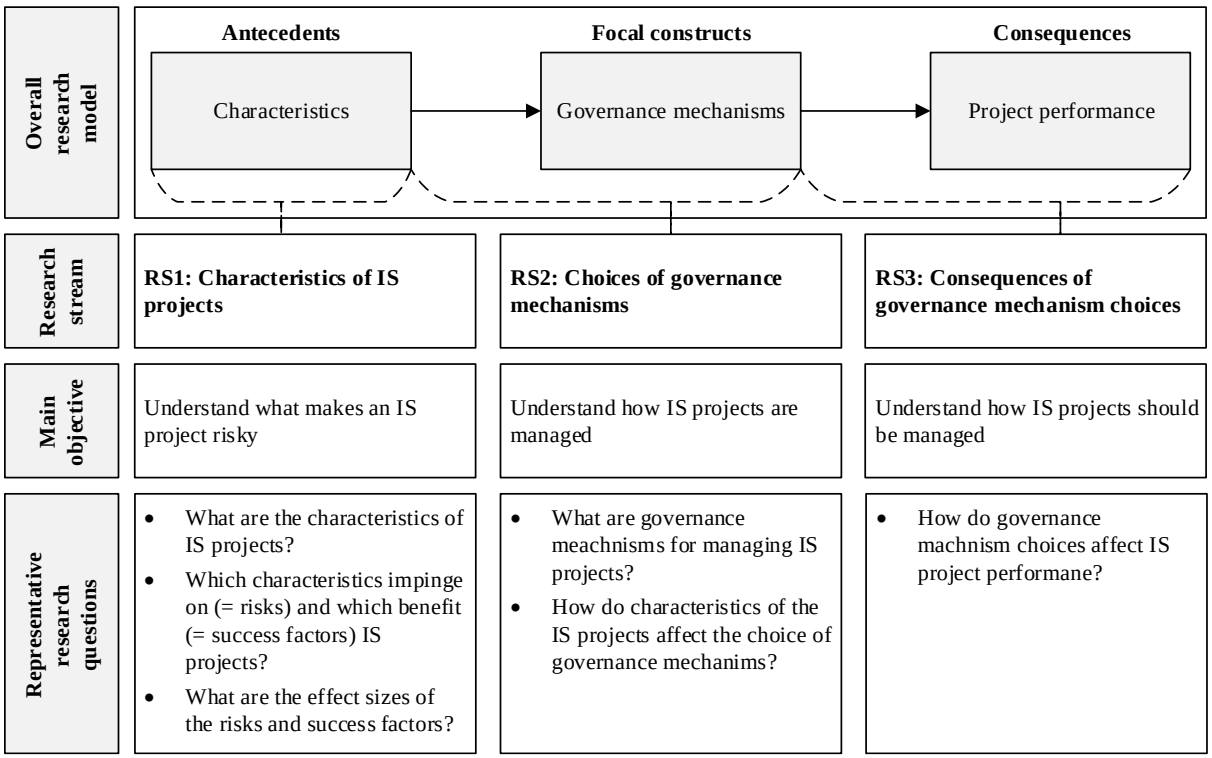
- **RS1: Characteristics of IS projects.** In RS1, the characteristics of IS projects are identified and investigated. The characteristics identified in this RS can be broadly categorized into characteristics of the IS project's task (task characteristics) and characteristics of the development team and users involved in the IS project (team and user characteristics). Task characteristics include, for example, technological complexity, requirements uncertainty, and project size (Anderson & Dekker, 2005; Gopal & Koka, 2010; Ramachandran & Gopal, 2010). Team and user characteristics include, for example, team size, team capabilities, user capabilities, and prior relationships between the team and the users (Ethiraj, Kale, Krishnan, & Singh, 2005; Gopal & Koka, 2012; Srivastava & Teo, 2012). In this research stream, IS project characteristics are often denoted as IS project risks if they are expected to have a negative impact on IS project performance (Barki, Rivard, & Talbot, 1993; Keil, Rai, & Liu, 2013), and denoted as IS project success factors if they are expected to have a positive effect on IS project performance (Chow & Cao, 2008; Hong & Kim, 2002). Examples for IS project risks are technological complexity and requirements uncertainty. Higher technological complexity and higher requirements uncertainty are expected to have a negative impact on IS project performance (Gopal & Koka, 2010; Harter, Krishnan, & Slaughter, 2000). Examples for success factors are team capabilities and user capabilities. Higher team capabilities and higher user capabilities are expected to have a positive effect on IS project performance (Ethiraj et al., 2005; Hsu, Lin, Zheng, & Hung, 2012). Within this RS, researchers composed comprehensive lists of IS project risks and IS project success factors, and ranked these lists by investigating the magnitude of the risks and success factors (Rai, Maruping, & Venkatesh, 2009; Saarinen & Sääksjärvi, 1992). So, by investigating the

characteristics of an IS project, the results of this RS can be used to discriminate potential risky from potential successful projects.

- **RS2: Choices of governance mechanisms.** In order to understand how IS projects are managed, RS2 evolved. In RS2, choices of governance mechanisms in IS projects are identified and investigated. Governance mechanisms can be broadly categorized into formal governance mechanisms and relational governance mechanisms (Goo, Kishore, Rao, & Nam, 2009; Poppo & Zenger, 2002; Rai, Keil, Hornyak, & Wüllenweber, 2012). Examples for formal governance mechanisms are type and structure of formal contracts (Goo et al., 2009). Examples for relational governance mechanisms are knowledge sharing and trust (J.-N. Lee & Kim, 1999). These governance mechanisms are implemented in IS projects to safeguard against the IS project risks identified in RS1 (K. J. Mayer & Nickerson, 2005). For example, contingency planning terms in formal contracts safeguard IS projects against "misunderstandings about each party's roles and responsibilities" (Argyres, Bercovitz, & Mayer, 2007, p. 4) that may arise in IS projects with requirements or technological uncertainty. Each governance mechanism has its particular pros and cons (Goo et al., 2009). For example, while contingency planning terms in formal contracts are useful to safeguard IS projects against the risks of requirements uncertainty, they do not safeguard IS projects against low development team capabilities. Hence, the choice of governance mechanisms for a specific IS project is contingent on the characteristics of that project (Anderson & Dekker, 2005; Tiwana, 2009). In RS2, therefore, various theories such as control theory, resource-based view (RBV), and transaction cost economics (TCE) are used to explain and predict the choice of specific governance mechanisms contingent on the characteristics of IS projects (Kirsch, 1996; Susarla, Barua, & Whinston, 2009; Watjatrakul, 2005). In this regard, researchers refer to IS project characteristics as antecedents or determinants of governance mechanisms (Kirsch, Ko, & Haney, 2010; Sakka, Barki, & Côté, 2013). So, the results of RS2 can be used to understand how IS projects are managed based on their characteristics.

- **RS3: Consequences of governance mechanism choices.** Based on empirical observations, researchers investigated in RS2 how IS projects are managed in practice. However, the results of RS2 do not inform how IS projects should be managed. To understand how IS projects should be managed, RS3 identified and investigated the consequences of governance mechanism choices on IS project performance. Depending on the perspective of the investigation, literature adopts different conceptualizations of IS project performance. From the perspective of a client, IS project performance is conceptualized in the form of product performance and process performance (Faraj & Sproull, 2000; Gopal & Gosain, 2010). Product performance refers to the extent to which the outcome of the IS project fulfills the functional and non-functional requirements (Henderson & Lee, 1992; Maruping, Venkatesh, & Agarwal, 2009). Process performance refers to the extent to which the budget and schedule plan are met (Barki & Hartwick, 2001; Keil et al., 2013). From the perspective of a vendor, IS project performance is conceptualized with absolute or relative profits (Ethiraj et al., 2005; Gopal & Koka, 2012). In RS3, researchers investigated the effects of various governance mechanism choices on these conceptualizations of IS project performance. Based on the results of RS3, normative guidelines for how IS projects should be managed were derived.

Figure 1 summarizes the three research streams and visualizes how they build on each other. On the one hand, RS2 builds on RS1 by using the characteristics of IS projects (identified in RS1) as antecedent factors to explain and predict the choices of governance mechanisms in IS projects. On the other hand, RS3 builds on RS2 by using the governance mechanisms (identified in RS2) to explain and predict IS project performance. Hence, all three research streams are necessary building blocks to investigate how IS projects should be managed.

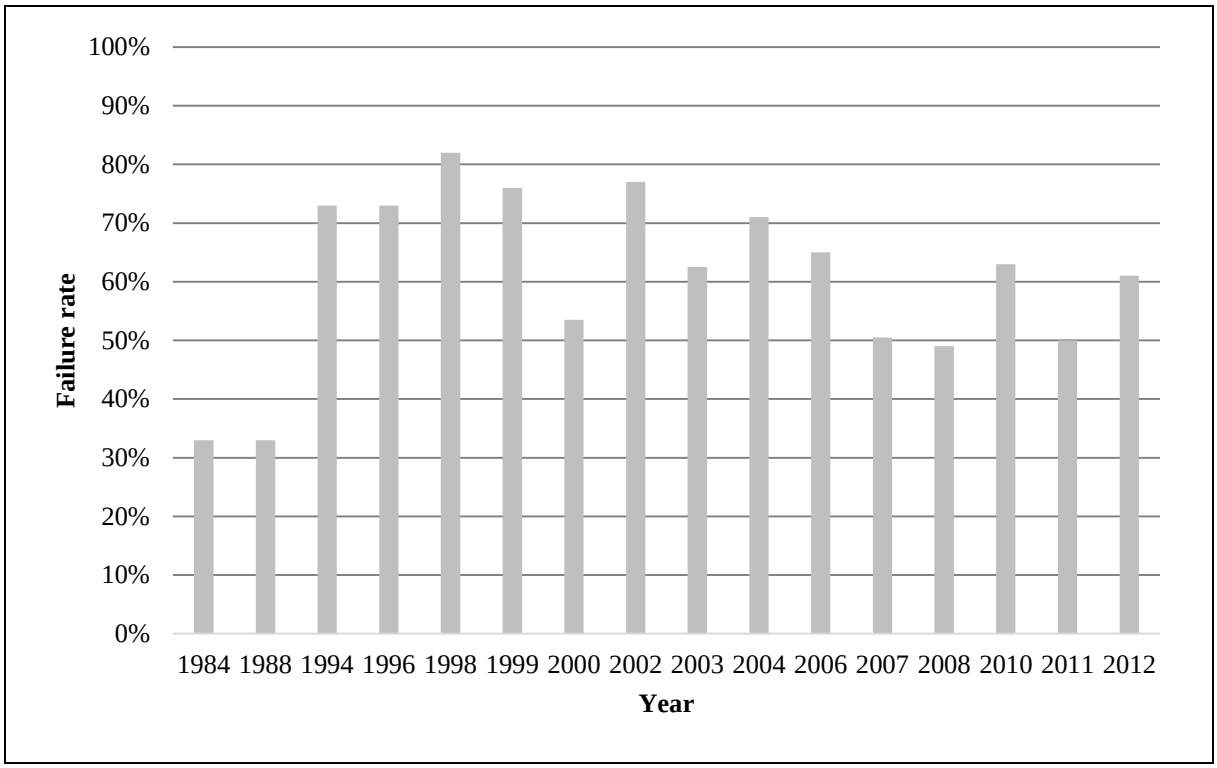


Notes. RS: research stream.

Figure 1. Summary of research streams in IS project research

1.2 Problem statement

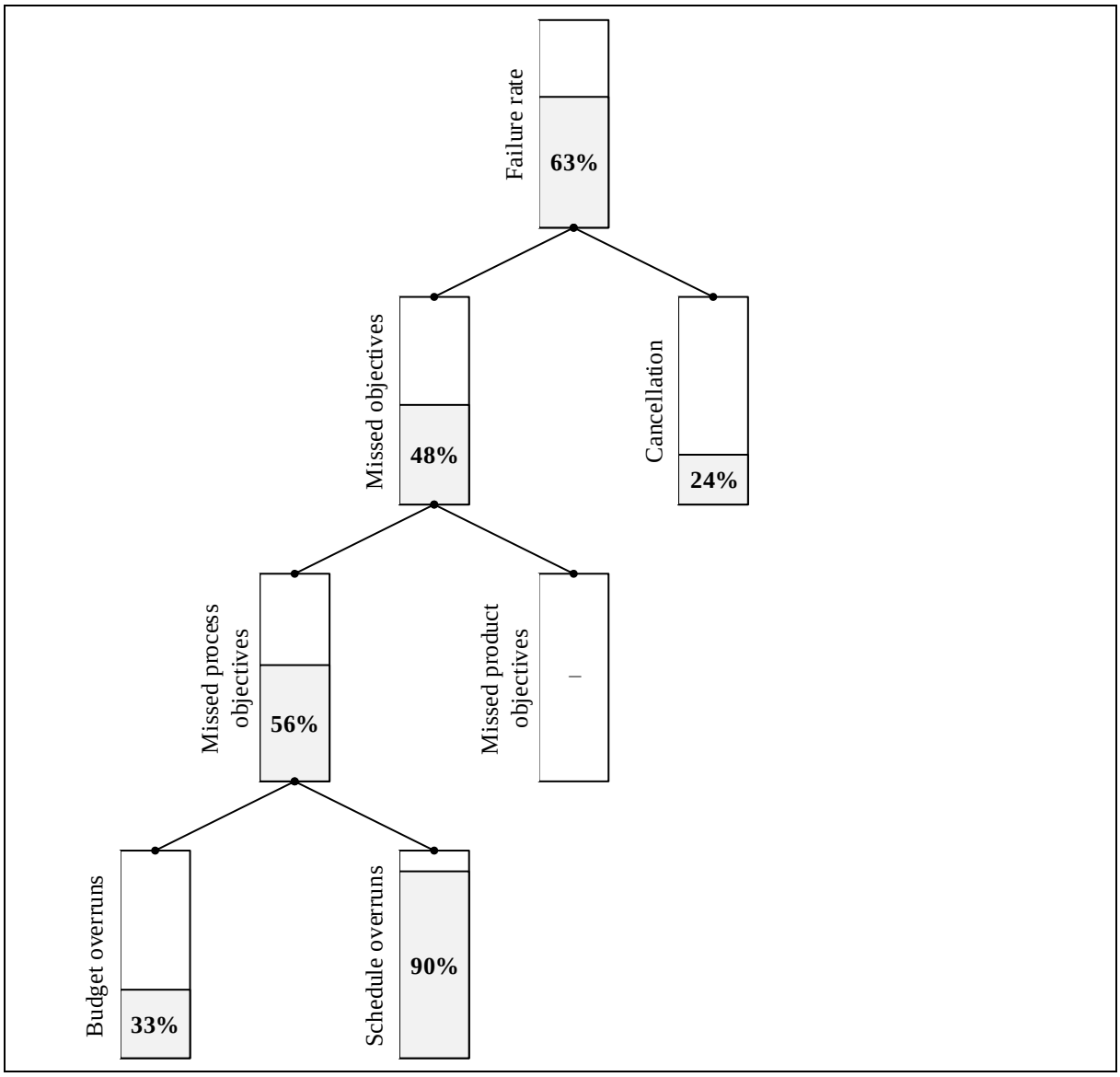
Despite the large amount of empirical studies in the research streams described in Section 1.1, industry reports (Bloch, Blumberg, & Laartz, 2012; Flyvbjerg & Budzier, 2011; Nelson, 2007; The Standish Group, 2013) and research studies (Lyytinen & Robey, 1999; Natovich, 2003; Sauer, Gemino, & Reich, 2007; Savolainen, Ahonen, & Richardson, 2012; Tadelis, 2007) still report high failure rates of IS projects. Figure 2 summarizes the IS project failure rates reported in industry and research reports between 1984 and 2012. The maximum failure rate is reported for the year 1998 with 82 percent of failed IS projects. The most recent failure rate is reported for the year 2012 with 61 percent of failed IS projects. It can be concluded that the failure rates have decreased only slightly during the past decades and still reflect a critical situation in 2012 with more than 50% of failed IS projects.



Notes. 1984: Jenkins, Naumann, and Wetherbe (1984); 1988: Phan, Vogel, and Nunamaker (1988);1994: Gibbs (1994); The Standish Group (2001); 1996: The Standish Group (2001); 1998: M. Martin (1998); The Standish Group (2001); 1999: Ambler (1999); Davids (1999); 2000: Keil, Mann, and Rai (2000); The Standish Group (2001); 2002: Hong and Kim (2002); Scott and Vessey (2002); The Standish Group (2009); 2003: Barker and Frolick (2003); Ptak and Schragenheim (2003); 2004: The Standish Group (2009); 2006: The Standish Group (2009); 2007: McManus and Wood-Harper (2007); Sauer et al. (2007); 2008: Krigsman (2008); The Standish Group (2009); 2010: The Standish Group (2013); 2011: Outsourcing Today (2012); 2012: The Standish Group (2013).

Figure 2. IS project failure rates as reported in industry and research reports by year of reported failure rate

These failure rates are measured in various ways. Basically, it can be distinguished between two types of failure rates: cancellation (Susarla, 2012; Susarla, Subramanyam, & Karhade, 2010) and missed objectives (Gelbard & Carmeli, 2009; The Standish Group, 2013; Yetton, Martin, Sharma, & Johnston, 2000). Cancelation or discontinuation of an IS project implies that the contract is canceled before the term of the contract (Susarla, 2012). Missed objectives can be divided into missed process objectives and missed product objectives. Missed process objectives include budget and schedule overruns (Susarla et al., 2009). Missed product performance objectives include not meeting functional and non-functional requirements (Barki & Hartwick, 2001). Figure 3 breaks down the failure rates reported in Figure 2 by the type of failure rates. Failure rates in terms of missed objectives are twice as high as failure rates in terms of cancellation (i.e., 48 percent and 24 percent, respectively). Schedule overruns as a measure of missed process objective are especially severe: 90 percent of all IS projects are subject to schedule overruns.



Notes. Failure rate: Ambler (1999); Barker and Frolick (2003); Davids (1999); Gibbs (1994); Hong and Kim (2002); Jenkins et al. (1984); Keil et al. (2000); Krigsman (2008); M. Martin (1998); McManus and Wood-Harper (2007); Outsourcing Today (2012); Phan et al. (1988); Ptak and Schragenheim (2003); Sauer et al. (2007); Scott and Vessey (2002); The Standish Group (2001, 2009, 2013); Missed objectives: Gibbs (1994); Jenkins et al. (1984); Krigsman (2008); M. Martin (1998); Phan et al. (1988); Sauer et al. (2007); Scott and Vessey (2002); The Standish Group (2001, 2009, 2013); Cancellation: The Standish Group (2001, 2009, 2013); Missed process objectives: Gibbs (1994); Jenkins et al. (1984); Krigsman (2008); M. Martin (1998); Phan et al. (1988); Scott and Vessey (2002); Missed product objectives: –; Budget overruns: Jenkins et al. (1984); Phan et al. (1988); Schedule overruns: Scott and Vessey (2002); If two or more studies report a failure rate for the same type of failure, the failure rates are averaged; Since failure rates are reported for types of failure rates on different levels of aggregation, the types of failure rates reported on one level of aggregation do not necessarily add up to the corresponding type of failure rates on the higher levels of aggregation.

Figure 3. IS project failure rates as reported in industry and research reports by type of reported failure rate

The high rates of failed IS projects reported in Figure 2 and Figure 3 suggest that the contemporary understanding of how to manage IS projects is still limited. In the following, plausible reasons for this limited understanding are presented under the headings of four research challenges (RC).

- **RC1: Weak empirical basis.** Empirical results in IS project research might suffer from Type II error because they are often based on small sample sizes (He & King, 2008; Joseph, Ng, Koh, & Ang, 2007). Most empirical research studies on IS projects are based on relatively small sample sizes (e.g., Harter et al., 2000; Hong & Kim, 2002; Leonard-Barton & Sinha, 1993). For example, the study with the fewest observations identified in this thesis analyzed 9 variables on the basis of 21 observations (Brodbeck, 2001). The vast majority of the studies identified in this thesis are based on sample sizes between 60 and 120 observations, which is relatively small compared with the number of variables included in the analyses of these studies. Hox (1998), for example, suggests a minimum of 20 observations for each variable included in the analysis. In their methodological book on meta-analysis, Hunter and Schmidt (2004) elaborate in detail on the importance of large sample sizes. According to Hunter and Schmidt (2004), analyses based on small sample sizes (they refer to samples with 50 to 300 observations as small) lack statistical power which leads to high Type II error rates in statistical hypotheses tests. Type II errors (also referred to as β-errors or false positives) occur when the null hypothesis is false in reality but the statistical hypothesis test fails to reject the null hypothesis (Cohen, 1988). Sufficient low Type II error rates often require sample sizes greater than 1,000 observations (F. L. Schmidt & Hunter, 1978). However, in IS project research, hypotheses tests are seldom based on such large sample sizes. Some notable exceptions are Staats, Brunner, and Upton (2011) and Staats, Milkman, and Fox (2012) who analyzed 1,203 and 1,118 IS projects, respectively. Overall, it can be concluded that IS project research lacks sufficient sample sizes to control for Type II errors.

- **RC2: Overgeneralization.** It is often difficult to generalize results and implications from empirical IS project research because research studies do not explicitly account for distinctive features of the research context and data sample used. On the theoretical plane, hypotheses are often universally formulated. On the empirical plane, however, the data which is used to test these hypotheses are often very specific. Examples for the characteristics of empirical settings in IS project research that vary between individual research studies are the task type (e.g., individual software development, standard software implementation, software as a service procurement, and total information technology (IT) outsourcing), project phase (e.g., analysis, design, implementation, test, and maintenance), sourcing model (e.g., internal vs. outsourced), governance type (e.g., fixed price contract vs. time and materials contract), and market conditions (e.g., mature vs. emerging markets). It seems reasonable to assume that these differences in empirical settings might influence the research results in terms of effect size or even effect direction. For example, Tiwana and Keil (2010) test the effect of control on IS project performance in internal compared with outsourced projects. Their results suggest that specific controls have a positive effect in internal projects but a negative effect in outsourced projects. While some studies exist that explicitly account for the specifics of the empirical setting or even compare results between different empirical settings (e.g., Gopal & Sivaramakrishnan, 2008; Tiwana & Keil, 2010), the vast majority of studies does not incorporate those specifics into their theoretical plane. As a result, empirical tests of identical hypotheses often lead to mixed or contrary results.

- **RC3: Unclear theoretical basis.** The theoretical basis in IS project research is weak because theoretically grounded empirical IS project research often leads to mixed results (Poppo & Zenger, 1998; Watjatrakul, 2005). So far, IS project research failed to develop an own theoretical basis to explain and predict IS project phenomena such as, for example,

why some IS projects are successful and why others are not (Lacity, Willcocks, & Khan, 2011). Instead, to study IS project phenomena, researchers often draw on theories from related disciplines, particularly from economics. Among the most frequently borrowed theories in IS project research are, for example, transaction cost economics, resource-based view, and control theory (e.g., Anderson & Dekker, 2005; Bharadwaj, 2000; Henderson & Lee, 1989). However, similar to RC2, empirical results obtained when using these theories to explain IS project phenomena are mixed. For example, Watjatrakul (2005) compares TCE with RBV in order to decide whether IS projects should be insourced or outsourced. He finds that, in some cases, TCE and RBV suggest different sourcing alternatives. Another example is the study of Nidumolu (1996a). He investigates coordination in IS projects by comparing a structural contingency and risk-based perspective. His findings suggest that the risk-based perspective outperforms the structural contingency perspective. However, he notes that none of these theories is perfect to study coordination in IS projects. These mixed results question the applicability of theories from related disciplines to IS project research. Some researchers even argue to move beyond these theories and call for the development of an own "endogenous" IS project theory (Lacity et al., 2011).

- **RC4: Fragmentation.** The relative importance of different constructs in empirical IS project research is unclear because use and operationalizations of constructs are fragmented. IS project researchers have accumulated a large body of literature with over 230 empirical research studies. Within this large body of literature, a multitude of different constructs and even more operationalizations of these constructs have been used to study IS projects. However, as most studies typically examine subsets of constructs or particular operationalizations of constructs, the extensive body of literature is highly fragmented. There is no comprehensive conceptual framework to classify the already investigated constructs and compare their relative effects.

1.3 Research questions

The overall objective of this thesis is to increase the understanding of how IS projects should be managed in order to increase IS project performance. To reach this understanding, it is necessary to address elements from the three research streams outlined in Section 1.1. Accordingly, four distinct studies have been conducted that can be mapped to one or more of the three research streams. For each study, the underlying motivation and the specific research question (RQ) are discussed next.

The main objective of RS1 is to identify and analyze the characteristics of IS projects. Within this RS, it is a central challenge to identify which characteristics may expose risks to the performance of IS projects. As a consequence, research on IS project risk has gained increasing attention in recent years (e.g., Keil et al., 2013; Kutsch & Hall, 2010; S. Liu, Zhang, Keil, & Chen, 2010). While this body of knowledge has considerably advanced our understanding of IS project risk, it rests on a single-sided perspective (see RC2): Much of the existing literature focuses on the client's perspective on risk in IS projects (e.g., Dibbern, Goles, Hirschheim, & Jayatilaka, 2004; Levina & Ross, 2003; Savolainen et al., 2012). Research has made only tentative attempts to systematically analyze IS project risk from the vendor's perspective. In light of the increasing importance of inter-organizational cooperation, it seems necessary to complement this focus on the client with the vendor's perspective on IS project risk (Kohli &

Grover, 2008). This thesis begins to complement these perspectives by analyzing which characteristics of an outsourced IS project are perceived as risks by vendors. Hence, the following research question will be answered in this thesis:

- **RQ1:** Do vendors include transaction characteristics in their risk estimation?

The main objective of RS2 is to understand how governance structures are designed to account for the risky characteristics identified in RS1. One governance mechanism that has drawn particular attention among researchers is the type of contract between client and vendor in outsourced IS projects (Gopal & Sivaramakrishnan, 2008; Gopal, Sivaramakrishnan, Krishnan, & Mukhopadhyay, 2003; Susarla & Barua, 2011). Based on the analytical framework of TCE, a large body of research aims to predict the contract type of an IS project contingent on the task uncertainty characteristic of this project (Kalnins & Mayer, 2004; Susarla et al., 2009). However, empirical results for this relationship are mixed (see RC3). On the one hand, for example, Gopal et al. (2003) and Susarla et al. (2009) find a positive relationship between task uncertainty and the choice of a time and materials contract. On the other hand, however, Rai et al. (2009) and Tiwana (2008a) find no significant relationship between task uncertainty and the choice of contract type. Based on the maturity of the information technology outsourcing (ITO) market (see RC2), this thesis develops and tests an explanation for these mixed results by answering the following research question:

- **RQ2:** Does the maturity of the ITO industry explain the variance in TCE-based findings for the effect of uncertainty on the choice between fixed price contracts, and time and materials contracts?

The main objective of RS3 is to investigate the consequences of governance choices for the performance of IS projects. Within this RS, control modes are a prime example of governance mechanisms. In recent years, research investigated the consequences of control modes on IS project performance for both internal and outsourced IS projects (Gopal & Gosain, 2010; Keil et al., 2013; Mao, Lee, & Deng, 2008). However, control relationships in internal and outsourced IS projects "are not explicitly separated in theoretical treatment" (Gopal & Gosain, 2010, p. 961) and a direct comparison of empirical findings is missing (see RC2 and RC3). This thesis directly addresses these challenges by answering the following research question:

- **RQ3:** How does the effect of control on IS project performance differ between hierarchical compared with market-based control relationships?

In IS project research, a wealth of studies exist that investigate particular IS project characteristics (RS1), particular governance mechanism choices based on these IS project characteristics (RS2), and performance consequences of these governance mechanism choices (RS3). However, this body of knowledge is highly fragmented (see RC4). A comparison and integration of these studies is missing and the relative effects of the characteristics and governance mechanisms on IS project performance are unclear. This thesis aims to integrate and compare the body of knowledge on IS project performance by answering the following research question:

- **RQ4:** What determines IS project performance?

1.4 Research studies

To answer the four research questions raised in Section 1.3, four empirical research studies were conducted within this thesis. An overview of these four research studies is given in the following. Specifically, the methodological approach, main findings, and contributions are summarized for each study (S).

- **S1: Transaction characteristics and risk estimations.** To investigate whether vendors include transaction characteristics in their risk estimations (RQ1), S1 examines the relationships between the risk estimation of vendors and four transaction characteristics: project size, contract type, strategic importance, and client familiarity. The hypotheses are that larger projects, fixed price contracts, and strategic projects are associated with higher risk estimations, and that greater client familiarity is associated with lower risk estimations. The hypotheses are tested using unique archival data on 81 projects from a major enterprise resource planning (ERP) vendor. Surprisingly, regression analysis shows that vendors do not include all transaction characteristics in their risk estimation. The findings suggest that the risk estimation is based on project size and contract type (i.e., larger projects and fixed price contracts are significantly associated with higher risk estimations) but not on strategic importance and client familiarity.

  Additionally, using information on realized project profitability, S1 analyzes the efficiency of the vendor's risk estimation. The vendor's risk estimation is said to be efficient with regard to the transaction characteristics if it incorporates all information related to the transaction characteristics available at the time of estimation. Accordingly, any deviation in realized project profitability should result from contingencies that are unanticipated and, thus, not incorporated in the risk estimation. Therefore, the hypothesis is that, in the presence of the vendor's risk estimation, there should be no significant effect of the transaction characteristics included in the risk estimation (i.e., project size and contract type) on realized project profitability. The hypothesis is tested by simultaneously regressing the transaction characteristics and the vendor's risk estimation on realized project profitability. The findings suggest efficiency of the vendor's risk estimation with regard to the transaction characteristics included in the risk estimation (i.e., project size and contract type are not significantly associated with realized project profitability). Finally, the efficiency analysis also suggests that vendors deliberately accept profitability losses when conducting strategic projects.

- **S2: TCE and ITO industry maturity.** To investigate whether the maturity of the ITO industry explains the variance in TCE-based findings (RQ2), S2 examines the relationship between task uncertainty and contract type choice in outsourced IS projects. TCE hypothesizes that the frequency with which time and materials contracts are chosen instead of fixed price contracts is a positive function of task uncertainty. Meta-analysis shows that the general association between task uncertainty and contract type choice is characterized by a small effect size and high variance. Based on the maturity of the ITO industry, an explanation for the high variance is developed and tested. The hypothesis is that the effect size of the relationship between task uncertainty and the frequency with which time and materials contracts are chosen instead of fixed price contracts is a negative function of ITO industry maturity. Meta-analytic results support this hypothesis and suggest that ITO industry maturity explains the high variance in the general relationship between task

uncertainty and contract type choice. Specifically, the results suggest that transaction cost economics is relevant to explain the choice of contract type in the emerging phase of the ITO industry but not in its current mature phase. The conclusion is that a TCE-based analytical framework is not well suited for the study of ITO in the current mature industry phase. Instead, the study suggests that an "endogenous" ITO theory should be developed that focuses on differences in client behavior rather than vendor behavior.

- **S3: Hierarchical and market-based control relationships.** To investigate the differences in the effects of control on IS project performance between hierarchical compared with market-based control relationships (RQ3), S3 analyzes the relationships between project performance and four modes of control: behavior control, outcome control, clan control, and self-control. Hypotheses on the effects of the control modes on IS projects performance for hierarchical and market-based control relationships are derived based on fundamental differences between these two forms of control relationships. For hierarchical control relationships, positive effects on IS project performance of behavior control, outcome control, and clan control, but not of self-control are hypothesized. For market-based control relationships, positive effects on IS project performance of outcome control, clan control, and self-control, but not of behavior control are hypothesized. Meta-analytic results support these hypotheses. Based on these findings, S3 derives implications for complementary and substitutive effects between control modes, and for interrelations among hierarchical and market-based control relationships.

- **S4: Determinants of IS project performance.** To investigate what determines IS project performance (RQ4), S4 proceeds in two steps. In the first step, a narrative review is conducted to identify and classify the determinants of IS project performance reported in the extant literature. The narrative review results in a framework of 22 conceptually distinct determinants of IS project performance that are classified into six categories. In the second step, within this framework, a meta-analysis is conducted to quantitatively aggregate the empirical findings on the effects of the determinants on IS project performance reported in the extant literature. The meta-analytic results show that the determinants trust, coordination, and knowledge integration have the strongest effect on IS project performance. On the other side, the determinants project size, IS team size, and technological uncertainty have the weakest effect on IS project performance. The study consolidates the understanding of IS project performance and provides avenues for further research.

Research challenge / study	**S1**	**S2**	**S3**	**S4**
RC1: Weak empirical basis		●	●	●
RC2: Overgeneralization	●	●	●	
RC3: Unclear theoretical basis		●	●	
RC4: Fragmentation				●

Notes. RC: research challenge; S: study; ●: addresses research challenge.

Table 1. Research challenges addressed by the research studies

Table 1 illustrates which of the research challenges raised in Section 1.2 are addressed by the empirical research studies embedded in this thesis. In the following, it is elaborated how the research challenges are addressed by the research studies.

- **RC1: Weak empirical basis is addressed by S2, S3, and S4.** This thesis addresses RC1 by using meta-analytic techniques to combine already existing empirical findings for the same phenomenon. Combining multiple research findings for the same phenomenon allows meta-analysis to take advantage of statistical information that is based on large (combined) sample sizes and, thus, to reduce Type II error rates (Hunter & Schmidt, 2004). This thesis increases the reliability of research findings by three meta-analytic studies (S2, S3, and S4).

- **RC2: Overgeneralization is addressed by S1, S2, and S3.** This thesis addresses RC2 by theorizing and empirically investigating differences in empirical research settings. Three studies address this challenge. The first (S1) complements the predominant client perspective on outsourced IS projects with the perspective of the vendor. The second (S2) compares governance choices in outsourced IS projects between two different stages of the IS outsourcing market. The third (S3) compares governance choices between internal and outsourced IS projects. In sum, this thesis shows that specifics of the empirical settings matter for sizes and directions of empirical findings.

- **RC3: Unclear theoretical basis is addressed by S2 and S3.** This thesis addresses RC3 by investigating sources for the mixed results when theories from related disciplines are used in IS project research. Two studies address this challenge. The first (S2) investigates the maturity of the IS outsourcing market as source of the mixed research results when TCE is applied as theoretical framework. The second (S3) investigates the sourcing type of an IS project as source of the mixed results when control theory is applied. In sum, this thesis shows that related theories are not universally applicable.

- **RC4: Fragmentation is addressed by S4.** This thesis addresses RC4 by reviewing the large body of literature. An integrated framework of the constructs used in IS project research is derived from literature. For the question of what determines the performance of IS projects, the relative effects sizes of the constructs identified in literature are compared (S4). In sum, this thesis aggregates and compares the constructs used in IS project research.

Table 2 presents additional information related to the publications associated with the research studies. This information includes the authors, full-length title, outlet, and the type of the publication (i.e., conference or journal publication) for each research study.

Study	Authors	Title	Outlet	Type
S1	Hoermann, Dongus, Schermann, Krcmar	Do vendors include transaction characteristics in their risk estimation: An empirical analysis of ERP projects	ICIS 2012	CON (VHB: A)
S2	Dongus, Yetton, Schermann, Krcmar	Transaction cost economics and industry maturity in IT outsourcing: A meta-analysis of contract type choice	ECIS 2014	CON (VHB: B)
S3	Dongus, Ebert, Schermann, Yetton, Krcmar	Control and performance in IS projects: A meta-analysis of hierarchical and market-based control relationships	ICIS 2014	CON (VHB: A)
S4	Dongus, Ebert, Schermann, Krcmar	What determines information systems project performance? A narrative review and meta-analysis	HICSS 2015	CON (VHB: C)

Notes. S: study; ICIS: International Conference on Information Systems; ECIS: European Conference on Information Systems; HICSS: Hawaii International Conference on System Sciences; CON: Conference; VHB: German Academic Association for Business Research.

Table 2. Publication-related information of the research studies

1.5 Thesis structure

Figure 4 illustrates the structure of the introduction to this thesis's publications (Part A). The current section (Section 1) begins by motivating this thesis and includes a brief review of research streams associated with the thesis's topic (Section 1.1). Then, the research challenges are motivated and described (Section 1.2), and research questions are formulated (Section 1.3). The empirical research studies to investigate the research questions are described next (Section 1.4). This section ends with a brief outlook on the following sections (Section 1.5). Section 2 gives an overview of the methodological approach (Section 2.1) and describes the two main research methodologies used in the empirical studies of this thesis to answer the research questions, namely linear regression analysis (Section 2.2) and meta-analysis (Section 2.3). Section 3 summarizes the findings of this thesis's studies (Section 3.1), discusses the limitations (Section 3.2), and presents the contributions and implications for research (Section 3.3), the implications for practice (Section 3.4), and avenues for future research (Section 3.5). The final section of Part A (Section 4) provides conclusive remarks.

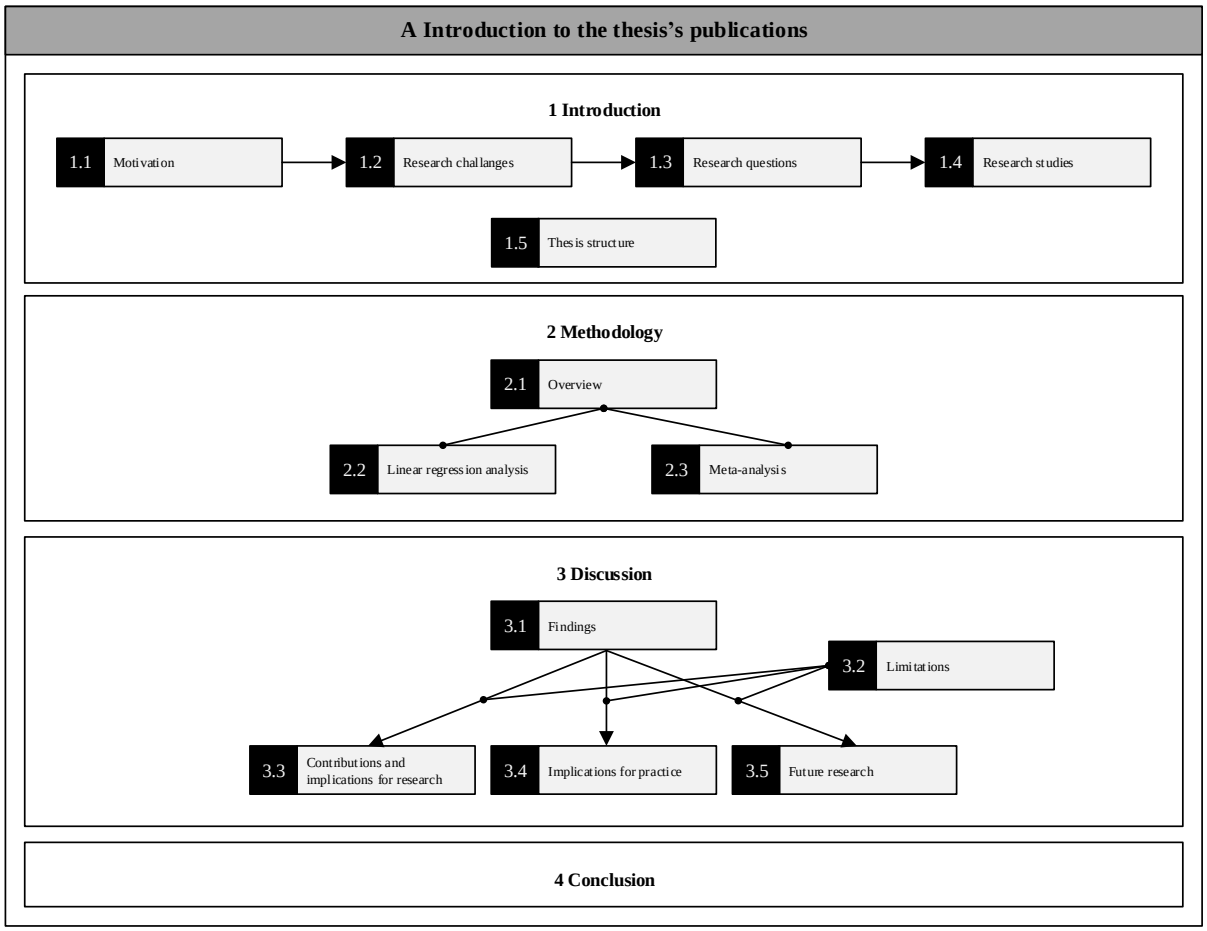


Figure 4. Structure of the introduction to the thesis's publications

2 Methodology

2.1 Overview

To answer the research questions of this thesis, a quantitative empirical approach is adopted. It can be distinguished between two forms of quantitative empirical analysis: primary analysis and meta-analysis. Primary analysis is the original form of research in which new data are collected and statistically analyzed (Glass, 1976). Primary analysis is typically adopted when investigating novel phenomena or when replicating investigations of established phenomena (Hunter & Schmidt, 2004).

Meta-analysis is a higher-order form of research in which the results of multiple primary analyses on the same phenomena are used as input data (Glass, 1976; Hedges & Olkin, 1985; Hunter & Schmidt, 2004). Meta-analysis aggregates the results of primary analyses into evidence of higher quality (Borenstein, Hedges, Higgins, & Rothstein, 2009). In addition, meta-analysis allows to detect and analyze variation among the results of primary analyses (F. L. Schmidt & Hunter, 1978).

The two forms of quantitative empirical research inform each other. On the one hand, the outputs of primary analyses are the inputs of – and are aggregated within – a meta-analysis (Borenstein et al., 2009). On the other hand, the output of a meta-analysis, especially in form of detected variance among the results of primary analyses, stimulates future research in form of novel primary analyses (Hunter & Schmidt, 2004). Figure 5 depicts the two forms of quantitative empirical research and their interactions.

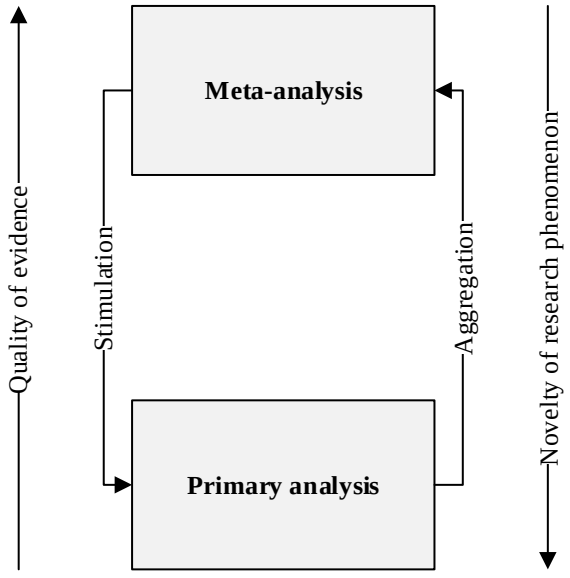


Figure 5. Interactions between primary analysis and meta-analysis

In the following, the form of research adopted for the empirical research studies included in this thesis is discussed. Table 3 summarizes the form of research adopted and the main reason for this adoption for each study.

- **S1 adopts a primary form of research** to examine whether vendors include transaction characteristics in their risk estimations. The vendor's risk estimation is a relatively novel phenomenon that has not achieved much attention in prior literature. Thus, a meta-analytic investigation would not be a feasible approach to study this phenomenon.

- **S2 adopts a meta-analytic form of research** to investigate whether the maturity of the ITO industry explains the variance in TCE-based findings. TCE is the most prominent analytical framework in ITO research (Dibbern et al., 2004; H. K. Klein, 2002). Consequently, a large body of empirical research is already available that can be used within a meta-analysis. Furthermore, prior reviews already point out that, in this body of research, there is high variance in the empirical research findings (Karimi-Alaghehband, Rivard, Wub, & Goyette, 2011; Lacity et al., 2011). Meta-analysis is specifically designed to analyze and explain variance in prior research findings (Hunter & Schmidt, 2004).

- **S3 adopts a meta-analytic form of research** to investigate the differences in the effects of control on IS project performance between hierarchical compared with market-based control relationships. On the one hand, data collection for both hierarchical and market-based control relationships within a single primary study would be barely feasible. On the other hand, there already exist empirical research findings for each form of control relationship in separation (Gopal & Gosain, 2010). Meta-analysis allows to integrate and compare these separate empirical findings within a single analysis (Hunter & Schmidt, 2004).

- **S4 adopts a meta-analytic form of research** to investigate the determinants of IS project performance. S4 aims at (1) a comprehensive overview of all determinants of IS project performance and (2) a comparison of their relative effect strengths. Regarding (1), such a comprehensive analysis would be barely feasible within a single primary study. Regarding (2), higher-order evidence as provided by a meta-analysis rules out study-specific effects and, thus, provides a more reliable comparison of the relative effect strengths (Hunter & Schmidt, 2004).

Study	**Form of research**	**Main reason for adopting the form of research**
S1	Primary analysis	Relatively novel phenomenon
S2	Meta-analysis	Detection and analysis of variation in the results of existing studies
S3	Meta-analysis	Detection and analysis of variation in the results of existing studies
S4	Meta-analysis	Aggregation of results of existing studies into higher-order evidence

Notes. S: study.

Table 3. Form of research adopted for each study

The following sections describe the specific statistical approaches adopted for conducting the primary and meta-analyses. Section 2.2 describes the linear regression analysis as the form of

primary analysis adopted in S1[1]. Section 2.3 describes the meta-analysis approach adopted in S2, S3, and S4.

2.2 Linear regression analysis

Linear regression analysis is an established and widely applied (for examples in IS research, see Gefen, Wyss, & Lichtenstein, 2008; Gopal & Sivaramakrishnan, 2008; Gopal et al., 2003; Rai, Keil, et al., 2012; Ramasubbu, Mithas, Krishnan, & Kemerer, 2008) form of quantitative statistical analysis to test linear associations between quantitatively measured variables. More specifically, between a metrical measured dependent variable and one (bivariate regression analysis) or multiple (multiple regression analysis) metrical or nominal (i.e., regression analysis with dummy variables) measured independent variables. A linear regression analysis proceeds in three steps: model specification, model estimation, and test of model assumptions.

Model specification

The ordinary linear model (OLM) is defined as follows.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_m X_m + \epsilon$$

This step is about defining the dependent variable Y and the independent variables $X_1, X_2, \ldots, X_m$ of the OLM. ϵ represents an error term that accounts for all variation in the dependent variable that cannot be explained by the independent variables (Shaver, 1998). Whereas the OLM is – per definition – linear in its parameters $\beta_0, \beta_1, \beta_2, \ldots, \beta_m$, it does not have to be linear in its independent variables (B. Hamilton & Nickerson, 2003). So, the independent variables can enter the OLM in a transformed way (e.g., in a logarithmical, exponential, or quadratic way). The selection of the variables and the specification of their functional form should be based on careful theoretical considerations (Hair, Black, Babin, Anderson, & Tatham, 2006).

Model estimation

Once the OLM is specified, the m parameters $\beta_0, \beta_1, \beta_2, \ldots, \beta_m$ are estimated using ordinary least squares (OLS). When a set of assumptions is met (see the third step – test of model assumptions), OLS is the best linear unbiased estimator (BLUE) for the parameters (Wooldridge, 2012). For the estimation process, a set of n observations (that are representative for the population of interest) for the variables of the model is collected:

$$(y_i, x_{1i}, x_{2i}, \ldots, x_{mi})_{i=1,\ldots,n}$$

Based on these observations, the following set of linear equations can be established:

$$y_i = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \cdots + \beta_m x_{mi} + \varepsilon_i, \qquad i = 1, \ldots, n$$

[1] In addition to the linear regression analysis, S1 also estimates ordered probit models using maximum likelihood. Background information on ordered probit models and maximum likelihood estimation can be found in, for example, Greene (2011).

where ε_i is the residual (unobserved error) for the ith equation. Using a matrix notation, this set of equations can be rewritten as:

$$\mathbf{y} = \mathbf{X}ß + \mathbf{e}$$

with $\mathbf{y} = (y_1, \dots, y_n)', \mathbf{X} = \begin{pmatrix} 1 & x_{11} & \cdots & x_{m1} \\ \vdots & \vdots & \ddots & \vdots \\ 1 & x_{1n} & \cdots & x_{mn} \end{pmatrix}, ß = (\beta_0, \beta_1, \dots, \beta_m)', \mathbf{e} = (\varepsilon_1, \dots, \varepsilon_n)'$

For hypothetical values $\mathbf{b} = (b_0, b_1, \dots, b_m)'$ for the parameters ß**,** the residuals can be calculated as follows:

$$\mathbf{e} = \mathbf{y} - \mathbf{X}\mathbf{b}$$

OLS produces estimates $\hat{ß} = \left(\hat{\beta}_0, \hat{\beta}_1, \dots, \hat{\beta}_m\right)'$ for the parameters ß by minimizing the sum of squared residuals (SSR):

$$\hat{ß} = \arg\min_{\mathbf{b}} SSR(\mathbf{b}) = \arg\min_{\mathbf{b}} \mathbf{e}'\mathbf{e}$$

Resolving the minimization problem for the argument **b** results in the following parameter estimates:

$$\hat{ß} = (\mathbf{X}'\mathbf{X})^{-1}\mathbf{X}'\boldsymbol{y}$$

Test of model assumptions

After estimating and testing the parameters of the model, the assumptions underlying the OLS estimator must be tested to ensure its properties. Table 4 gives an overview of the properties of the OLS estimator.

Property	**Mathematical expression**	**Description**
(P1) Unbiasedness	$E(\hat{ß}\|\mathbf{X}) = ß$	The expected value of the OLS estimator is equal to the true parameter value
(P2) Consistency	$Var(\hat{ß}\|\mathbf{X}) \xrightarrow{n\to\infty} 0$	The variance of the OLS estimator converges to zero as the sample size increases
(P3) Efficiency	$Var(\hat{ß}\|\mathbf{X}) = \min_{\mathbf{b}} Var(\mathbf{b}\|\mathbf{X})$	The OLS estimator is the minimum variance (so-called "best") linear estimator

Notes. P: property.

Table 4. OLS properties

Table 5 lists the assumptions underlying the OLS estimator and describes how violations of these assumptions threaten its properties.

Assumption	**Mathematical expression**	**Description**	**Consequences of violation**
(A1) Linearity	$\mathbf{y} = \mathbf{X}ß + \mathbf{e}$	Dependent variable is a linear function of a specific set of independent variables, plus an error	Invalidation of P1 and P2
(A2) Exogeneity	$E(\mathbf{e}\|\mathbf{X}) = 0$	Independent variables don't carry useful information for prediction of the residuals	Invalidation of P1 and P2
(A3) Identifiability	$\text{Rank}(\mathbf{X}) = m,$ $n \geq m$	No exact linear relationships between the independent variables (no complete multicollinearity), and more observations than independent variables	• Under complete multicollinearity, the OLS estimator cannot be derived (technical restriction) • High (but not complete) multicollinearity is no violation of A3 und does not invalidate the properties of the OLS estimator. However, high multicollinearity inflates the variance of the OLS estimator
(A4) Spherical Disturbances	$Var(\mathbf{e}\|\mathbf{X}) = \sigma_e^2 I$	Homoscedastic and non-autocorrelated residuals	Invalidation of P3
(A5) Normality	$\mathbf{e}\|\mathbf{X} \sim \mathcal{N}(0, \sigma_e^2 I)$	Residuals are normally distributed	Invalidation of P3

Notes. A: assumption; P: property.

Table 5. OLS assumptions

The specific procedures adopted to test the assumptions of OLS are described in the methodology section of S1 (Section 5.5).

2.3 Meta-analysis

Meta-analysis is a set of quantitative techniques to aggregate and analyze quantitative empirical research findings that are reported for a relationship between two constructs of interest (Borenstein et al., 2009; Glass, 1976; Hedges & Olkin, 1985; Hunter & Schmidt, 2004). The quantitative aggregation of research findings allows to obtain more reliable effects sizes between two constructs compared to an individual study (Hunter & Schmidt, 2004). In addition, the analysis of these effect sizes allows to detect unexplained variance in the relationship between two constructs, and to explain this variance by testing potential moderators to the relationship (F. L. Schmidt & Hunter, 1978). A meta-analysis typically proceeds in three steps: literature search, coding of constructs, and meta-analytic calculations (Hunter & Schmidt, 2004).

Literature search

The goal of meta-analysis is to obtain the "true" effect for the relationship of interest (Borenstein et al., 2009; Hunter & Schmidt, 2004). Therefore, meta-analysis seeks to include every study that has been conducted on this relationship, no matter if published in a good journal, in a conference article, or published at all (Cooper, Hedges, & Valentine, 2009). Systematically excluding some sort of studies could potentially bias the meta-analytic results (Rosenthal & DiMatteo, 2001). For example, consider the so-called "file-drawer problem": Not including unpublished studies could potentially bias the results towards a larger effect size because non-significant results have a lower tendency to get published and, therefore, more often remain in the researcher's file-drawer (Rosenthal, 1979).

Consequently, for the meta-analyses reported in this thesis, it was searched extensively for all kinds of empirical studies reported in journals, conference proceedings, dissertations, working papers, and forthcoming journal papers. Conference proceedings, dissertations, and working papers were specifically included to address the "file drawer-problem" mentioned above (King & He, 2005; Kohli & Devaraj, 2003).

A four-step search procedure was employed to minimize the chances of missing relevant studies (Cooper, 2010; Sharma & Yetton, 2003, 2007; J. Wu & Lederer, 2009). First, systematic keyword searches were conducted using a large number of electronic databases (J. Wu & Lederer, 2009). The selection of electronic databases ensured that all major journals and conference proceedings in the IS and management discipline are included in the keyword searches. Second, based on the studies retrieved in the first step, forward and backward searches were conducted (Webster & Watson, 2002). Third, to identify working papers and forthcoming journal papers, the websites of key authors identified in step one and step two were screened, keyword searches were conducted in Google, and the Social Science Research Network (SSRN) was searched. Fourth, requests for unpublished working papers were sent on several mailing lists (e.g., AISworld and Academy of Management (AOM) Organizational Communication and Information Systems (OCIS)).[2]

[2] Since the research question of S4 is too broad for a mailing list request, step 4 was conducted only for S2 and S3.

Table 6 lists the electronic databases used for the systematic keyword searches and the main journals and conference proceedings that are included in these electronic databases. Table 7 lists the keywords used for each of the meta-analyses included in this thesis (S2, S3, and S4).

Database	**Journals and conference proceedings**
Business Source Premier Journal STORage (JSTOR) ScienceDirect ABI/INFORM Association for Computing Machinery (ACM) Digital Library Institute of Electrical and Electronics Engineers (IEEE) Xplore The Association for Information Systems Electronic Library (AISeL) ProQuest Dissertations and Theses WorldCat Dissertations and Theses	Management Information Systems Quarterly (MISQ) Information Systems Research (ISR) Journal of Management Information Systems (JMIS) Management Science (MS) Academy of Management Journal (AMJ) Strategic Management Journal (SMJ) International Conference on Information Systems (ICIS) Americas Conference on Information Systems (AMCIS) European Conference on Information Systems (ECIS) Hawaii International Conference on System Sciences (HICSS)

Table 6. Electronic databases used in the systematic keyword searches

Study	**S2**	**S3**	**S4**
Keywords	One or more of several keywords related to IS outsourcing projects (i.e., “software”, “information system”, “information technology”, “outsourcing”) and one or more of several keywords related to contract type (i.e., “contract”, “fixed price”, “time and materials”, “cost plus”) and their variants (e.g., “fixed-price”)	One or more of several keywords related to control (i.e., “control”, “formal”, “informal”) and one or more of several keywords related to IS projects (i.e., “information system”, “information technology”, “software”)	One or more of several keywords related to IS projects (i.e., “software”, “information system”, “information technology”, “project”) and one or more of several keywords related to project performance (i.e., “success”, “performance”, “satisfaction”) and their variants (e.g., “successful”)

Table 7. Keywords used in the systematic keyword searches

Coding of constructs

After identifying all relevant studies for a meta-analysis, the variables of these studies must be coded to the theoretical constructs of interest (Hunter & Schmidt, 2004). Since existing literature often uses different aliases for the same construct or similar names for conceptually different constructs, coding schemes were developed that contain a single definition for each construct (Lipsey & Wilson, 2001). The variables of the relevant studies were then assigned to the construct based on the fit of their operationalization to the construct definition in the coding schemes (Kirca et al., 2011).

Meta-analytic calculations

The effect sizes were obtained in the form of zero-order Pearson product-moment-correlation coefficients. The correlation coefficient is the most frequently used effect size in meta-analyses in IS (e.g., He & King, 2008; Joseph et al., 2007; Sabherwal, Jeyaraj, & Chowa, 2006; Sharma, Yetton, & Crawford, 2009; J. Wu & Lederer, 2009) and is, as a scale-free measure, easy to interpret (Rosenthal & DiMatteo, 2001). Fisher's z transformation was not applied to the correlation coefficients because this would result in an upward bias that is usually larger than the downward bias that results from using untransformed correlation coefficients (Hall & Brannik, 2002; Hunter & Schmidt, 2004). Thus, the meta-analyses produce rather conservative estimates of the effect sizes.

If a single study (or a set of studies that is based on the same sample) reports more than one variable that can be mapped to the same construct, the corresponding effect sizes were averaged (Hunter & Schmidt, 2004). This is a common procedure to avoid biased estimates that could result from including dependent effect sizes in a meta-analysis (e.g., He & King, 2008; Palmatier, Dant, Grewal, & Evans, 2006).

The correlation coefficients were corrected for measurement error to achieve more accurate estimates of the true effects and to facilitate more reliable statistical inference. Every individual study is subject to measurement error that attenuates the estimated effects (Hunter & Schmidt, 2004). Following Hunter and Schmidt (2004), the correlation coefficients were individually corrected for error in the measurement of the independent and the dependent variable: The correlation coefficients were divided by the product of the square root of the reliability coefficients of the measurement of the independent and the dependent variable. If a measurement was based on a single-item or a proxy variable, a conservative standard of 0.8 was adopted for the reliability coefficient (Bommer, Johnson, Rich, Podsakoff, & MacKenzie, 1995; Dalton, Daily, Certo, & Roengpitya, 2003; Dalton, Daily, Ellstrand, & Johnson, 1998; Dalton, Daily, Johnson, & Ellstrand, 1999; K. Jiang, Lepak, Hu, & Baer, 2012; Sleesman, Conlon, McNamara, & Miles, 2010).

Based on the corrected (and, in case of dependent effect sizes, averaged) correlation coefficients, Hunter and Schmidt's (2004) random effects model was used to calculate the following meta-analytic outcomes for a relationship between two constructs: number of effect sizes (k), total sample size (N), average corrected correlation (average rho; $\bar{\rho}$), standard deviation of rho (SD_ρ), 95 percent confidence interval around the average rho ($CI_{\bar{\rho};.95}$), 80 percent credibility interval around the average rho ($CR_{\bar{\rho};.80}$), percentage of variance that is accounted for by statistical artifacts ($\%V$), and Cochran's (1954) chi-square test for

heterogeneity (Q). In contrast to the confidence interval, which refers to the accuracy of a single estimate – the average rho –, the credibility interval refers to the distribution of the rhos and is used to assess the generalizability of the average rho (Hunter & Schmidt, 2004). Credibility intervals that are relatively large or include zero suggest that the average rho cannot be generalized (Whitener, 1990), that is, the distribution of the rhos is heterogeneous. Concerning the percentage of variance that is accounted for by statistical artifacts, Hunter and Schmidt (2004) suggest generalizability of a relationship if more than 75 percent of the observed variance in the rhos can be accounted for by statistical artifacts. Then it is likely that the remaining variance is also due to statistical artifacts that have not been observed. Regarding Cochran's (1954) chi-square test for heterogeneity, significant values of Cochran's (1954) chi-square test imply a heterogeneous relationship. Table 8 summarizes the formulas proposed by Hunter and Schmidt (2004) to calculate these meta-analytic outcomes.

Definition	**Formula**
Number of effect sizes	k
Uncorrected effect size *l*	r_l
Sample size of effect size *l*	n_l
Independent variable measurement error of effect size *l*	$r_{l;xx}$
Dependent variable measurement error of effect size *l*	$r_{l;yy}$
Total sample size	$N = \sum_l n_l$
Sample-size-weighted average of uncorrected effect sizes	$\bar{r} = \frac{\sum_l n_l r_l}{N}$
Error of effect size *l*	e_l
Sampling variance of effect size *l*	$Var(e_l) = \frac{(1-\bar{r}^2)^2}{n_l - 1}$
Attenuation factor to correct effect size *l* for measurement error	$a_l = \sqrt{r_{l;xx}} \cdot \sqrt{r_{l;yy}}$
Effect size *l* corrected for measurement error (corrected effect size *l*)	$r_{l;corrected} = \frac{r_l}{a_l}$
Sampling variance of effect size *l* corrected for measurement error	$Var(e_l)_{corrected} = \frac{Var(e_l)}{{a_l}^2}$
Weight of effect size *l*	$\omega_l = (n_l - 1)\ {a_l}^2$
Sum of weights across effect sizes	$W = \sum_l \omega_l$

Weighted average of corrected effect sizes (average rho)	$\bar{\rho} = \overline{r_{corrected}} = \frac{\sum_l \omega_l r_{l;corrected}}{W}$
Variance of corrected effect sizes	$Var(r_{corrected}) = \frac{\sum_l \omega_l (r_{l;corrected} - \overline{r_{corrected}})^2}{W}$
Average of corrected sampling variances	$\overline{Var(e)_{corrected}} = \frac{\sum_l \omega_l Var(e_l)_{corrected}}{W}$
Variance of corrected effect sizes corrected for sampling variance (variance of rho)	$Var(\rho) = Var(r_{corrected}) - \overline{Var(e)_{corrected}}$
Standard deviation of corrected effect sizes corrected for sampling variance (standard deviation of rho)	$SD_\rho = SD(\rho) = \sqrt{Var(\rho)}$
Standard deviation of corrected effect sizes	$SD_r = SD(r_{corrected}) = \sqrt{Var(r_{corrected})}$
Standard error of the estimator of the average rho	$SE_{\bar{\rho}} = SE(\bar{\rho}) = \frac{SD(r_{corrected})}{\sqrt{k}}$
Percentage of variance that is accounted for by statistical artifacts	$\%V = \frac{\overline{Var(e)_{corrected}}}{Var(r_{corrected})}$
80 percent credibility interval	$CR_{\bar{\rho};.80} = \bar{\rho} \pm 1.28\, SD(\rho)$
95 percent confidence interval	$CI_{\bar{\rho};.95} = \bar{\rho} \pm 1.96\, SE(\bar{\rho})$
Cochran's (1954) chi-square statistic for heterogeneity	$Q = \sum_l \omega_l (r_{l;corrected} - \overline{r_{corrected}})^2$

Table 8. Formulas used for the meta-analytic calculations

Subgroup-analysis was used to investigate moderating effects to the relationship of interest. In doing so, the set of correlation coefficients used to calculate the meta-analytic outcomes was split into two or more subsets according to the value of the moderating variable (Dalton et al., 1998). Then, the meta-analytic outcomes described above were calculated for each subgroup separately.

Two methods can be used to test whether the moderator significantly explains differences in the effects sizes between the subgroups. The first method, described by Borenstein et al. (2009), is an analysis of variance (ANOVA)-like procedure (see, e.g., T.-Y. Park & Shaw, 2013). It is based on a decomposition of Cochran's (1954) chi-square statistic for heterogeneity: The total amount of heterogeneity (Q) can be decomposed in the heterogeneity that is explained by the moderator variable ($Q_{between}$) and the heterogeneity that remains within the subsamples (Q_{within}). A significant $Q_{between}$-statistic means that variance in the effect sizes of a relationship is significantly explained (and, thus, moderated) by the moderator variable. The

second method is a two-sample Z-test (see, e.g., Quinones, Ford, & Teachout, 1995). A relationship with a significant Z-statistic suggests that the effect sizes differ between the subgroups. Whereas the two-sample Z-test can only test differences between two subgroups, the ANOVA-like procedure can test differences between multiple subgroups. Table 9 summarizes the formulas for the moderation test methods.

Definition	**Formula**
Cochran's (1954) chi-square statistic for heterogeneity within subsample o	$Q_o = \sum_{l \in o} \omega_l (r_{l;corrected} - \overline{r_{corrected}})^2$
Cochran's (1954) chi-square statistic for heterogeneity within all subsamples	$Q_{within} = \sum_o Q_o$
Cochran's (1954) chi-square statistic for heterogeneity that is explained by partitioning into subsamples	$Q_{between} = Q - Q_{wihtin}$
Weighted average of corrected effect sizes (average rho) within subsample o	$\bar{\rho}_o$
Two-sample Z-statistic	$Z = \frac{\bar{\rho}_1 - \bar{\rho}_2}{\sqrt{SE(\bar{\rho}_1)^2 + SE(\bar{\rho}_2)^2}}$

Table 9. Formulas used for the meta-analytic moderation tests

3 Discussion

3.1 Findings

In the following, the findings of this thesis are summarized. Specifically, the main results are presented for each empirical research study and it is described how these results answer the research questions formulated in Section 1.3. Table 10 summarizes the key findings for each study.

- **Effects of transaction characteristics on vendor risk estimations:** The results of S1 suggest that not all transaction characteristics are included in the vendor's risk estimations. On the one hand, project size and contract type are included in the vendor's risk estimation. As hypothesized, larger projects and fixed price contracts are significantly associated with higher vendor risk estimations. On the other hand, strategic importance and client familiarity are not included in the vendor's risk estimations. Contrary to the hypotheses, strategic projects are not significantly associated with higher vendor risk estimations, and higher client familiarity is not significantly associated with lower vendor risk estimations. Based on these results, the answer to RQ1 is as follows. In general, vendors do include some but not all transaction characteristics in their risk estimation.

  In addition, with regard to the transaction characteristics included in the risk estimation (i.e., project size and contract type), S1 suggests that the vendor's risk estimation is efficient. In the presence of the vendor's risk estimation, project size and contract type are not significantly associated with realized project profitability. With regard to the transaction characteristics that are not included in the risk estimation (i.e., strategic importance and client familiarity), the results are as follows. In the presence of the vendor's risk estimation, strategic projects are significantly associated with lower realized project profitability, and client familiarity is not significantly associated with realized project profitability. This analysis also shows that higher risk estimations significantly predict lower realized project profitability.

- **Relationships between task uncertainty and contract type choice in two ITO industry maturity phases:** The results of S2 show that, in general, the relationship between task uncertainty and the choice of time and materials contracts is weak. The effect size is small by conventional standards (Cohen, 1988) and includes a significant amount of heterogeneity, suggesting that the relationship is moderated by other variables. Partitioning the data used to calculate this relationship into two subsamples by their ITO industry maturity phase provides more nuanced findings. In the emerging phase of the ITO industry, the relationship between task uncertainty and the choice of time and materials contracts is statistically significant and is characterized by a larger effect size than in the undifferentiated case. In the mature phase of the ITO industry, the relationship is not statistically significant and characterized by a smaller effect size than in the undifferentiated case. An additional moderator test suggests that this variance in effect sizes is significantly explained by the maturity phase of the ITO industry. Based on these results, the answer to RQ2 is as follows. The maturity of the ITO industry significantly explains the variance in TCE-based findings for the effect of task uncertainty on the choice between fixed price contracts, and time and materials contracts.

- **Relationships between control modes and IS project performance in two forms of control relationships:** The results of S3 show that, for some control modes, the effects on IS project performance differ between hierarchical compared with market-based control relationships. Behavior control is significantly associated with higher IS project performance in hierarchical but not in market-based control relationships. Outcome control and clan control are significantly associated with higher IS project performance in hierarchical and in market-based control relationships. Self-control is significantly associated with higher IS project performance in market-based but not in hierarchical control relationships. Based on these results, the answer to RQ3 is as follows. The effect of control on IS project performance differs between hierarchical compared with market-based control relationships for behavior and self-control. In hierarchical control relationships, behavior control has a significant positive effect on IS project performance, but self-control has not. In market-based control relationships, self-control has a significant positive effect on IS project performance, but behavior control has not.

- **Determinants of IS project performance:** The results of S4 take two forms. One result form is a conceptual framework of the determinants of IS project performance investigated in IS project research. The framework consists of 22 conceptually distinct determinants of IS project performance classified into six categories. The categories are project characteristics, IS team characteristics, user characteristics, user/IS team characteristics, relational processes, and formal processes. The category project characteristics contains determinants of IS project performance that are related to the project and the task of the project: technological uncertainty, requirements uncertainty, technological complexity, organizational complexity, and project size. The category IS team characteristics contains determinants of IS project performance that are related to the IS development team: IS team size, IS team capabilities, IS team diversity, and IS team autonomy. The category user characteristics contains determinants of IS project performance that are related to the user: user capabilities. The category user/IS team characteristics contains determinants of IS project performance that are related to the relationship between the user and the IS team: prior interactions between the user and the IS team. The category relational processes contains determinants of IS project performance that are related to relational processes that occur within the project: communication, coordination, mutual support, cohesion, knowledge integration, trust, management support, and user participation. The category formal processes contains determinants of IS project performance that are related to formal processes that occur within the project: outcome formalization, coordination formalization, and development process formalization.

  The other result form is a meta-analytic aggregation of the empirical findings reported in the extant literature for the effects of the 22 determinants on IS project performance. The meta-analytic results suggest that project management through relational and formal processes has a higher effect on IS project performance than ex-ante characteristics and risks (related to the IS team, the user, the IS team/user relationship, and the project). Comparing both forms of processes, relational processes have a higher effect on IS project performance than formal processes. Comparing the effect strengths of the ex-ante characteristics, the characteristics related to the IS team, the user, and their relationship have a higher effect on IS project performance than characteristics related to the project. RQ4 is answered by the combination of both result forms. The conceptual framework presents the

Study	Findings

S1	• Relationships between transaction characteristics and vendor risk estimations
	  ○ Larger projects and fixed price contracts are significantly associated with higher vendor risk estimations
	  ○ Strategic importance and client familiarity are not significantly associated with the vendor's risk estimations
	• Efficiency of the vendor's risk estimation
	  ○ The vendor's risk estimation is efficient with regard to transaction characteristics included in the risk estimation (i.e., project size and contract type)
	  ○ Strategic projects and higher risk estimations are significantly associated with lower project profitability

S2	• Relationship between task uncertainty and contract type choice
	  ○ In general, the relationship between task uncertainty and the choice of time and materials contracts is characterized by a small effect and high heterogeneity
	  ○ In the emerging phase of the ITO industry, the relationship between task uncertainty and the choice of time and materials contracts is statistically significant and characterized by a larger effect size than in the general case
	  ○ In the mature phase of the ITO industry, the relationship is not statistically significant and characterized by a smaller effect size than in the general case
	  ○ Variance in effect sizes is significantly explained by the maturity phase of the ITO industry

S3	• Relationships between control modes and IS project performance
	  ○ In hierarchical control relationships, behavior control, outcome control, and clan control are significantly associated with higher IS project performance, but self-control is not
	  ○ In market-based control relationships, outcome control, clan control, and self-control are significantly associated with higher IS project performance, but behavior control is not

S4	• Conceptual framework of the determinants of IS project performance
	  ○ 22 determinants classified into six categories (project, IS team, user, and user/IS team characteristics, and relational and formal processes)
	• Relative effect sizes of the determinants on IS project performance
	  ○ Processes have a higher effect on IS project performance than characteristics
	  ○ Relational processes have a higher effect on IS project performance than formal processes
	  ○ IS team, user, and relationship characteristics have a higher effect on IS project performance than project characteristics

Notes. S: study.

Table 10. Summary of key findings for each study

determinants of IS project performance and the meta-analytic results present the effect strengths for the relationships between the determinants and IS project performance.

3.2 Limitations

There are four major attributes that characterize the validity of a research study (Bhattacherjee, 2012): internal validity, external validity, construct validity, and statistical conclusion validity. In this section, each of these validity types is briefly described and it is discussed how threats to these validities could potentially affect the findings of this thesis and the implications from these findings. It is further evaluated how these threats to validity should be addressed in future research. Table 11 summarizes the potential validity threats to the findings of this thesis.

- **Internal validity** (or causality) "examines whether the observed change in a dependent variable is indeed caused by a corresponding change in hypothesized independent variable, and not by variables extraneous to the research context" (Bhattacherjee, 2012, p. 35). There are three conditions for internal validity (Bhattacherjee, 2012). First, covariation (i.e., correlation, in linear relationships) between cause (independent variable) and effect (dependent variable). Second, cause precedes effect in time. Third, all other explanations are ruled out. Internal validity is a general problem of all non-experimental empirical research (Gravetter & Forzano, 2011). Whereas it is generally feasible to satisfy the first two conditions (covariation and temporal precedence) by non-experimental studies, all rival explanations can only be reliably ruled out in controlled experimental settings (Gravetter & Forzano, 2011). Consequently, all four studies conducted within this thesis (S1, S2, S3, and S4) are potentially affected by internal validity threats and should be interpreted accordingly.

- **External validity** (or generalizability) "refers to whether the observed associations can be generalized from the sample to the population (population validity), or to other people, organizations, contexts, or time (ecological validity)" (Bhattacherjee, 2012, p. 36). Concerning population validity, S1 may be threatened because data are only available for projects exceeding € 250,000. The sample of S1 is therefore slightly biased towards larger projects and the results may not be representative to the whole population of outsourced ERP projects conducted by ALPHA. However, because of the considerable costs associated with a formal risk management process, the practical implications of S1 may not be applicable to smaller projects anyway.

  S2, S3, and S4 may be also subject to population validity threats because it is not possible to identify and include all relevant empirical research studies into the meta-analyses. Although extensive literature searches are conducted, the possibility remains that not all relevant studies are identified. Furthermore, some studies do not report the necessary statistics and, thus, are not included in the meta-analyses. However, the extensive nature of the search process allows to be confident that any excluded studies would not substantially affect the results of S2, S3, and S4.

  The population validities of S2, S3, and S4 are additionally threatened by the file-drawer problem (Rosenthal, 1979). This refers to the potential bias that the results of unpublished studies differ systematically from the results of published studies. However, to address this issue, extensive searches for conference papers, dissertations, and working papers are

conducted. Therefore, the file-drawer problem is not expected to be a potential major validity threat to the results of S2, S3, and S4.

Concerning ecological validity, S1 examines outsourced ERP projects as a specific type of outsourced IS projects. Amongst other things, ERP projects are specific with regard to their high degree of client-vendor interaction and organizational change, the need to integrate with legacy systems, and the deployment of pre-packaged software (Markus & Tanis, 2000). Hence, generalizing the results of S1 to other types of IS projects, such as outsourced software development projects, may require additional research.

In addition, ecological validity in S1 may be also threatened by the fact that ALPHA's organizational context may not be comparable to other companies that provide ERP implementation and post-implementation services. ALPHA does not only offer services to its clients, but also develops and distributes its own ERP software. This differentiates ALPHA from other ERP service providers.

- **Construct validity** "examines how well a given measurement scale is measuring the theoretical construct that it is expected to measure" (Bhattacherjee, 2012, p. 37). With regard to S1, ALPHA's conceptualization for strategic importance may differ from those of other ERP service providers. For instance, ALPHA may also consider service projects as strategic that are primarily conducted in order to sell software licenses. More importantly, project objectives based on which the projects' strategic importance is coded are entered by the bid team that negotiates the project contracts. Post-hoc interviews with ALPHA risk managers revealed that this perspective may in some cases differ from the projects' actual strategic importance: The bid team may overstate the strategic importance in order to justify poorly negotiated contracts with low profitability prospects. This case offers an alternative explanation for the results: Being aware of the bid team's behavior, risk managers would not incorporate the bid team's perspective on a project's strategic importance into their risk estimation. Also, poorly negotiated contracts with an overstated strategic importance would drive the association between strategic importance and lower project profitability.

  The meta-analytic procedure applied in S2, S3, and S4 includes a coding of variables from individual studies to theoretical constructs. Mapping multiple variables with slightly varying operationalizations between individual studies to a single theoretical construct may threaten the validity of that construct (Heugens & Lander, 2009). However, for this coding process, detailed and strict coding schemes are designed. In these coding schemes, variables are assigned to theoretical constructs based on their explicit use in primary studies (Bullock & Svyantek, 1985). When this was in doubt, the assignment was discussed and resolved between the co-authors (Geyskens, Steenkamp, & Kumar, 2006).

- **Statistical conclusion validity** "examines the extent to which conclusions derived using a statistical procedure is valid" (Bhattacherjee, 2012, p. 37). In the meta-analytic studies (S2, S3, and S4), the results are only corrected for the three statistical artifacts that are present in every individual study: sampling error, measurement error of the independent variable, and measurement error of the dependent variable. Hunter and Schmidt (2004) describe procedures to correct for other statistical artifacts including range restriction and dichotomization of continuous variables. However, information that must be extracted from the individual studies to correct for these artifacts is rarely available and is, thus, beyond the scope of these studies.

The moderator analyses in S2 and S3 are based on a rather small number of effect sizes. Whereas a small number of effect sizes does not bias the estimates of the expected rhos, it does affect the estimate of the standard deviation of the rhos that are used to calculate the credibility intervals (Hunter & Schmidt, 2004). Therefore, in addition, Hunter and Schmidt's (2004) 75 percent rule and Cochran's (1954) chi-square test for heterogeneity are estimated. There is no evidence of bias in the findings presented in S2 and S3.

Validity threats	**S1**	**S2, S3, and S4**
Internal validity	• Non-experimental data	• Non-experimental data
External validity	Population validity: • Sample is restricted to projects that exceed a certain budget threshold Ecological validity: • Data from only one vendor • Data for only one project type	Population validity: • Not every individual study could be identified (file-drawer problem) or included (relevant data not reported) into the analysis
Construct validity	• Operationalization of strategic importance is vendor-specific and may partially deviate from established constructs	• Assignment of slightly varying variables to a single theoretical construct
Statistical conclusion validity		• Individual studies are corrected for only three statistical artifacts • Moderator analyses are based on a small number of effect sizes (only S2 and S3)

Notes. S: study.

Table 11. Summary of potential validity threats

3.3 Contributions and implications for research

This thesis offers four main contributions to research. These four contributions and their implications for research are discussed next. Figure 6 summarizes the thesis's contributions to IS project research.

- **S1 contributes to RS1 by complementing the predominant client perspective on IS project risk with the perspective of the vendor.** In RS1, there is considerable research on IS project risk from a client's perspective, in particular on the relative importance of risks (Alter & Ginzberg, 1978; Boehm, 1991; S. Liu et al., 2010; McFarlan, 1981; Mursu, Lyytinen, Soriyan, & Korpela, 2003; R. C. Schmidt, Lyytinen, Keil, & Cule, 2001), the empirical effect of risk on IS project success (Gemino, Reich, & Sauer, 2008; J. J. Jiang & Klein, 2001; Keil et al., 2013; Sauer et al., 2007; Wallace, Keil, & Rai, 2004a; Yetton et al., 2000), normative guidelines for IS project risk management (Charette, 1996; Heemstra & Kusters, 1996; Powell & Klein, 1996; Ropponen & Lyytinen, 1997) and their usefulness

(Du, Keil, Mathiassen, Shen, & Tiwana, 2007; Kutsch & Hall, 2010). However, research has made only tentative attempts to analyze IS project risk from the vendor's perspective. S1 is one of the first attempts to empirically do so.

The results of S1 confirm and extend previous research. The results confirm that two of the determinants of IS project risk from a client's perspective also hold true from a vendor's perspective. Project size and fixed price contracts are significantly positively associated with the vendor's estimation of IS project risk (Gemino et al., 2008; Gopal et al., 2003; Lacity & Hirschheim, 1993; McFarlan, 1981; Yetton et al., 2000).

Besides confirming previous research from the client's perspective, the results of S1 extend previous research in two ways. First, S1 highlights the strategic importance of projects from the vendor's perspective as an important construct in the context of client-vendor relationships (S. Liu & Wang, 2014). Strategic importance indicates that objectives such as winning important reference clients, entering new markets, testing new technologies, or generating follow-up projects are vital for vendors. The results empirically substantiate the notion of 'must-have projects' and strategic vendor behavior. Prior research has only partially addressed strategic importance by focusing on aspects such as future business potential (Gopal et al., 2003), or has investigated strategic importance using non-empirical methods such as analytical modeling (Whang, 1995). Second, S1 proposes alternative interpretations of the role of familiarity in client-vendor relationships. In contrast to previous literature (e.g., Gefen et al., 2008), the findings suggest that familiarity does not mitigate IS project risk from the vendor's perspective.

In addition, the results of S1 suggest that vendors are able to efficiently estimate IS project risk with regard to the two characteristics that affect the estimation, that is, project size and contract type. As efficient estimations of IS project risk are prerequisites for effective IS project risk management, the results of S1 support previous research on the meaningfulness of IS project risk management (Baskerville & Stage, 1996; Du et al., 2007).

- **S2 contributes to RS2 by developing and empirically testing an explanation for the mixed results in ITO research when TCE is used as analytical framework.** In RS2, two recent reviews on ITO research report high variance in research results when TCE is used as analytical framework (Karimi-Alaghehband et al., 2011; Lacity et al., 2011). Even though the two reviews provide competing explanations for the variance in research results, they do not empirically test these explanations. S2 proposes and investigates a third explanation that is based on the maturity of the ITO industry. The results of S2 support the proposed explanation and, thereby, partially reconcile the competing explanations from Karimi-Alaghehband et al. (2011) and Lacity et al. (2011).

  Karimi-Alaghehband et al. (2011) argue that insufficient rigor, such as varying construct operationalizations, may have caused the mixed TCE-support in empirical ITO research. The results of a robustness check indicate that methodological rigor does indeed play an important role in explaining the mixed results in the emerging phase of the ITO industry.

  In contrast, Lacity et al. (2011) argue that TCE may not be applicable to the ITO context because the assumptions underpinning TCE may not hold for client-vendor relationships in the ITO industry. The results of S2 show that, while the assumptions of vendor opportunism

and information asymmetries between client and vendor may have held in the emerging phase of the ITO industry, they do not hold in the mature phase.

The critical implication of S2 is that a TCE-based analytical framework is not relevant to ITO research post 2001. As the ITO market is now maturing or is already mature, the implications from S2 support Lacity et al.'s (2011) general conclusion to move beyond TCE and develop an "endogenous" ITO theory.

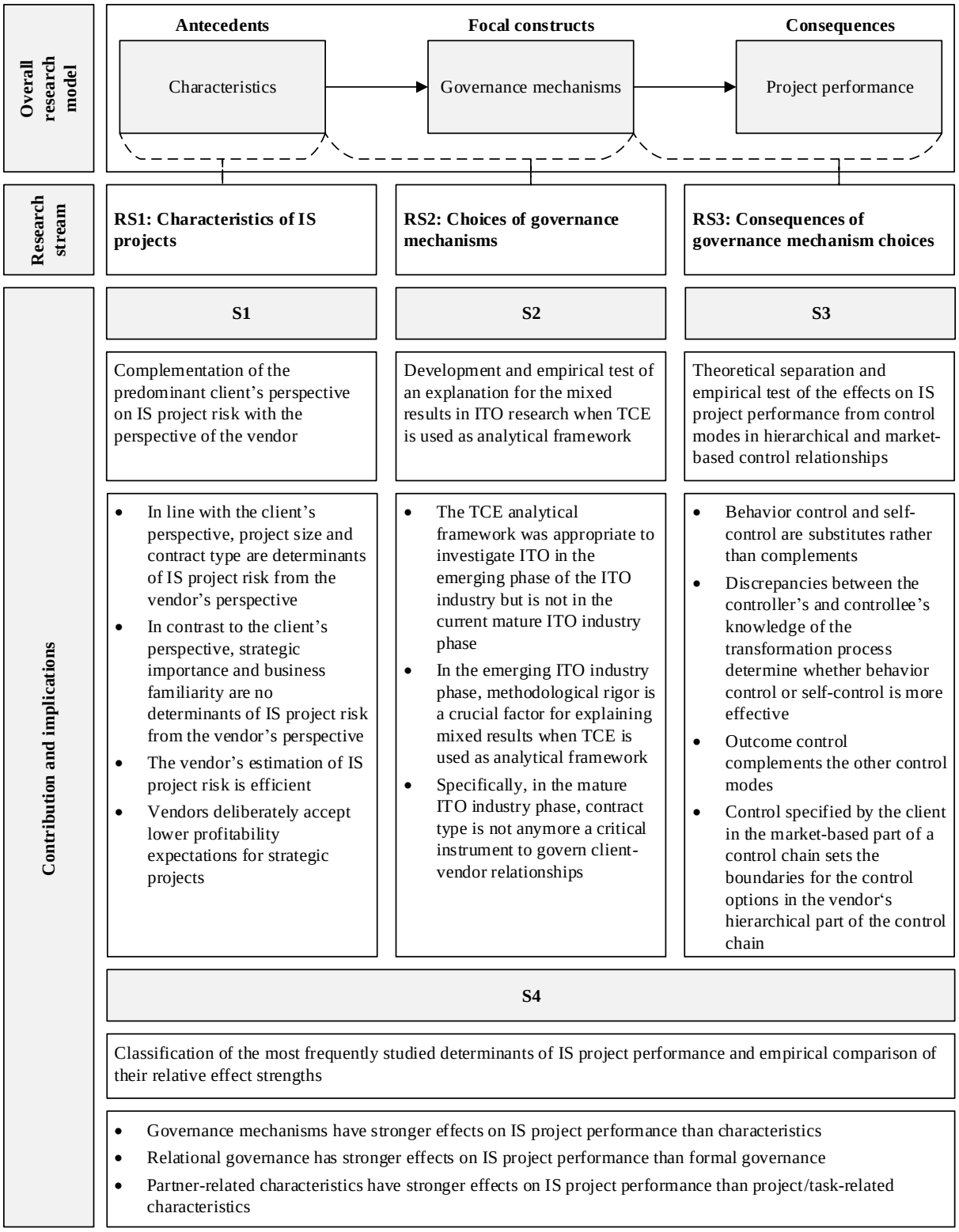
- **S3 contributes to RS3 by theoretically separating and empirically testing the effects of control on IS project performance in hierarchical and market-based control relationships.** In RS3, two forms of control relationships in IS projects exist: hierarchical and market-based control relationships. Extant literature typically studies one of these forms of control relationships in isolation. Hence, the differences and similarities between hierarchical and market-based control relationships are not explicit (Gopal & Gosain, 2010). S3 theoretically conceptualizes and empirically tests the differences between these forms of control relationships.

  The results of S3 have implications for how the structure of control portfolios differs between hierarchical compared with market-based control relationships and for the interrelations among hierarchical and market-based control relationships. With regard to the structure of control portfolios, the results of S3 suggest that self-control and behavior control are substitutes rather than complements. Prescribing behavior using behavior control supersedes self-set actions enabled by self-control. It is suggested that the choice between behavior control and self-control is a function of the discrepancy between the controller's and the controllee's knowledge of the transformation process. If the controller's knowledge of the transformation process exceeds the controllee's knowledge of the transformation process, behavior control is more effective. Otherwise, self-control is more effective. Outcome control is effective in both cases and is suggested to complement either behavior control or self-control to establish and secure desired outcomes.

  With regard to the interrelations among hierarchical and market-based control relationships, S3 adopts Ouchi's (1978) transmission of control framework as a theoretical lens. The results of S3 suggest that control that is specified by a client in a market-based control relationship sets the boundaries for the vendor project manager's options to control their project team members. In this regard, the market-based control relationship between the client and the vendor, and the hierarchical control relationship within the vendor organization between the project manager and project team members form a mixed market-based/hierarchical control chain. The results of S3 suggest that outcomes prescribed by a client transmit consistently through the mixed market-based/hierarchical control chain to the project team members. Behavior control prescribed by clients limits the vendor project manager in effectively prescribing their own, presumably based on superior knowledge of the transformation process, behavior control. On the other side, when clients refrain from using behavior control in the market-based part of the control chain and, instead, grant self-control, vendors can effectively establish behavior control in the hierarchical part of the control chain, leading to superior IS project performance. Clan control emphasized by the client is suggested to transmit through the control chain, but is reduced in its effect on the vendor project team by the vendor's internal, possibly slightly deviating, norms and beliefs.

- **S4 contributes to RS1, RS2, and RS3 by classifying the most frequently studied determinants of IS project performance and empirically comparing their relative effect strengths.** There is an extensive body of IS project research, covering the characteristics of IS projects (RS1), choices of governance mechanisms (RS2), and consequences of these governance mechanism choices (RS3). However, this body of research is highly fragmented. Particular characteristics and governance mechanisms are usually investigated in isolation. This fragmentation leads to two problems. First, an exhaustive overview of the most important characteristics and governance mechanisms is missing. Second, the relative effects of these characteristics and governance mechanisms on IS project performance are unclear. S4 addresses both of these problems. With respect to the first one, S4 identifies and classifies the most frequently investigated characteristics and governance mechanisms that are supposed to affect IS project performance. With respect to the second one, S4 meta-analytically compares the magnitudes of the effects of these characteristics and governance mechanisms on IS project performance.

  The results from comparing the relative effect strengths have three major implications. First, governance mechanisms (RS3) have, without exception, a stronger effect on IS project performance than characteristics of the project environment (RS1). Second, within the group of governance mechanisms (RS3), relational governance mechanisms (e.g., trust, mutual support, communication) have, with the only exception of cohesion, a stronger effect on IS project performance than formal governance mechanisms (e.g., outcome formalization, coordination formalization). Third, within the group of characteristics (RS1), partner characteristics (i.e., IS team characteristics, user characteristics) have a stronger effect on IS project performance than characteristics that are related to the project and the project's task (e.g., technological uncertainty, requirements uncertainty).



Notes. RS: research stream; S: study.

Figure 6. Summary of the contributions to the research streams in IS project research

3.4 Implications for practice

The overall objective of this thesis is to increase the understanding of how IS projects should be managed in order to increase IS project performance. Accordingly, this section provides

guidelines for project managers on how to manage IS projects, and for clients of outsourced IS projects on how to manage the relationship with the vendor.

- **Beware of strategic IS projects.** Vendors frequently conduct projects for strategic reasons, including winning reference clients, entering new markets, testing new technologies, or generating follow-up projects (Carmel & Agarwal, 2002). Frequently, the vendor's bargaining power is compromised in strategic projects and they, therefore, accept unfavorable contractual conditions for the sake of strategic benefits (Susarla et al., 2010). Consistently, the results of S1 show that strategic projects are significantly associated with lower project profitability. The results of S2 also suggest that the trade-off between strategic benefits and short-term profitability objectives should be explicitly incorporated into project calculation and planning. In ALPHA's case, profitability requirements are deliberately relaxed for strategic projects. As a consequence, the project manager is not held responsible for the amount of strategically relaxed profitability and, thus, still able to meet realistic goals. Based on ALPHA's overall success in the market, other vendors may also consider explicit incorporation of strategic objectives into project calculation and planning.

- **Establish a formal IS project risk management process.** The results of S1 illustrate the benefits of a formal IS project risk management process: ALPHA's risk estimation significantly predicts project profitability. Moreover, the results of S1 suggest that the risk estimation is efficient with regard to important transaction characteristics such as project size or contract type. Although it was not possible to quantify the amount of mitigated risk within S1, these findings suggest that the risk managers have a good understanding of the risks in IS projects. It is highly likely that the IS projects benefit strongly from this understanding.

- **Do not rely on tight contracts to protect against potential vendor opportunism in outsourced IS projects**. Extant literature proposes that clients in ITO projects should choose a contract type in order to protect themselves against potential vendor opportunism in form of shirking or opportunistic renegotiations (Ethiraj et al., 2005; Gopal et al., 2003). Whereas the results of S2 provide some support for this reasoning in the emerging phase of the ITO market, the results provide no support for this reasoning in the current mature phase of the ITO market. Instead, the results of S2 indicate that, in the mature phase of the ITO industry, clients should refrain from tightly controlling the behavior of the vendor and build good relational governance to leverage the vendor's capabilities to deliver high performance. The relationship between client and vendor is transformed from a potentially adversarial to a collaborative one.

- **Adapt portfolio of control to the specific context.** The results of S3 highlight the importance of adapting a control portfolio to the specific context. Whereas outcome and clan control have positive effects on IS project performance regardless of the specific context, behavior and self-control function as substitutes that should be chosen according to the specific context: Behavior control has a positive effect on IS project performance only in hierarchical contexts, and self-control has a positive effect on IS project performance only in market-based contexts. Hence, on the one hand, project managers who control their project team members hierarchically should include a combination of outcome, clan, and behavior control into the portfolio of control. On the other hand, client representatives who

control vendors in a market-based control relationship should include a combination of outcome, clan, and self-control into the portfolio of control.

- **Manage IS projects on a relational level.** The results of S4 clearly show that relational processes have the highest effect on IS project performance compared with formal processes and project and partner characteristics. Especially, it is important to build trust and emphasize communication and coordination between team members and project partners. Project managers should stimulate teamwork in terms of knowledge integration and mutual support between team members. Furthermore, it is important to integrate external stakeholders: Support from top management and participation of the users are strong drivers of IS project performance. In an outsourcing context, the results of S2 underpin the importance of strong relational governance in a mature market setting by showing that the contract is less important to mitigate task uncertainty risks. The results of S3 reinforce this guidance by demonstrating positive effects of clan control within and between organizations.

- **Focus on capabilities rather than technical risks.** As expected, the results of S4 confirm that technical risks, such as project size and technological uncertainty, have a negative effect on IS project performance. However, these negative effects are lower than the positive effects of strong capabilities on the side of the IS team and on the side of the client. This suggests that first priority should be given to selection of an IS team with strong technological capabilities. With the support of a user group with strong domain knowledge, such an IS team will be able to cope with technical risks more easily while maintaining full functionality of the IS solution. Focusing on reducing technical risks, instead, could have potential negative effects on achieving the required functionality.

3.5 Future research

Naturally, it is impossible for a doctoral dissertation to deal with all phenomena, open questions, and issues of an extensive research area such as IS project research. Moreover, answering research questions often raises subsequent research issues. Hence, based on the findings of the four studies included in this thesis, this section presents promising avenues for future IS project research.

- **Compare the client's and the vendor's perspective on IS project risk by investigating more determinants.** Prior literature predominantly investigated the client's perspective on IS project risk (Dibbern, Winkler, & Heinzl, 2008; Kirsch, Sambamurthy, Ko, & Purvis, 2002; M. A. Smith & Kumar, 2004). In contrast, this thesis (S1) investigates the vendor's perspective on IS project risk by examining the effects of four characteristics on the vendor's estimation of IS project risk. Future research could extent this endeavor in two ways. First, by directly comparing the client's and the vendor's perspective on IS project risk within a single study. A direct comparison using identical questionnaire items for clients and vendors would allow to compare the relative contributions of different characteristics on IS project risk between clients and vendors. Second, by considering a more comprehensive list of characteristics as drivers of IS project risk. This would lead to a more comprehensive view of IS project risk and its components as considered by clients and vendors.

- **Investigate the effects of repeated interactions in outsourced IS projects.** Prior literature disagrees on the effects of repeated interactions between clients and vendors in outsourced IS projects. For example, Gefen et al. (2008) and Kalnins and Mayer (2004) find that repeated interactions are associated with time and materials contracts. On the other hand, for example, Tiwana (2008d) finds no significant relationship between repeated interactions and contract type. The results of S1 could not resolve these existing disagreements: The effect of repeated interactions on IS project risk from the vendor's perspective is not significant. Future research should investigate this issue in more detail to explain the mixed results present in prior literature.

- **Examine strategic importance in more detail.** The results of S1 suggest that vendors deliberately accept lower project profitability when conducting strategic projects. This issue of strategic vendor behavior would be interesting to investigate in more detail. For example, consider the following questions. Are there different levels of strategic importance? How much profitability loss are vendors willing to accept for different levels of strategic importance? What is the return of strategic projects in terms of follow-up projects with the same client? What is the return of strategic projects in terms of increased reputation to win similar projects with other customers in the same industry? What are the bidding strategies to maximize the total payoffs from reduced short-term profitability and increased long-term business?

- **Empirically analyze the benefits of IS project risk management.** The results of S1 indicate that realized project profitability of IS vendors can be predicted by their risk estimation. A higher risk estimation is associated with lower realized project profitability. However, this significant association also shows that the risk managers cannot fully mitigate the risks (i.e., residual risks remain). To fully understand the benefits of IS project risk management, future research should investigate what amount of the initial risks can be mitigated and how much residual risks remain. Comparing this information with the costs associated with IS project risk management would considerably inform the question whether IS project risk management pays off.

- **Further examine the effects of ITO industry maturity phases.** The results of S2 clearly demonstrate the effect of different ITO industry maturity phases on TCE-based contract type choice predictions. To substantiate the claim that the explanatory power of TCE varies between ITO industry maturity phases, future research should investigate other TCE-based ITO predictions for different levels of ITO industry maturity. Furthermore, it would be interesting to investigate whether the level of ITO industry maturity affects the explanatory power of other theories used in the ITO context, for example, RBV.

- **Develop an endogenous ITO theory**. For the current mature market phase of the ITO industry, the results of S2 reinforce Lacity et al.'s (2011) argument that TCE is not suitable to explain ITO-related phenomena. Thus, S2 supports Lacity et al.'s (2011) call for the development of an own "endogenous" ITO theory. Lacity et al. (2011) already put forward some cornerstones of such an ITO theory. Adding to this, both the results of S2 and S3 suggest that an endogenous ITO theory should focus on how clients can leverage the vendor's superior capabilities instead of tightly controlling the vendor's behavior.

- **Directly examine interaction effects between control modes.** Although the nature of the results of S3 suggest implications about complementary and substitutive effects among

different control modes, a direct proof of these implications was not possible in S3. Future research should directly and separately examine these interaction effects for market-based and hierarchical control relationship. Besides confirming the implications suggested by S3, potential benefits of such an analysis could comprise further insides on how clan control interacts with the other control modes, an issue not covered by S3.

- **Directly examine the transmission of control through mixed market-based/hierarchical control chains.** The results of S3 suggest that control exercised by a client over a vendor in a market-based control relationship sets the boundaries for the vendor's scope of action to control its project team members in the internal hierarchical control relationships. However, to directly test these suggestions and examine the links between market-based and hierarchical control relationships in more detail, further data collection is necessary. Specifically, for each project, data should be collected at three points along the mixed market-based/hierarchical control chain: client representative (on the control exercised over the vendor project manager), vendor project manager (on the control received from the client representative, and on the control exercised over the vendor project team members), vendor project team members (on the control received from the vendor project manager). Based on these data, it could be investigated how particular control modes, or even complete control portfolios, are transmitted through the integrated control chain.

- **Investigate interaction effects between project characteristics.** S4 presents an extensive overview of the effects on IS project performance from characteristics of the project environment. It was, however, not part of S4 to examine the interaction effects of those characteristics on IS project performance. Such interaction effects could either be investigated in form of moderation/mediation analyses for two particular characteristics or cluster analyses to derive typologies and associated risk profiles of IS projects. Such analyses would not only lead to a more nuanced understanding of the effects of particular characteristics on IS project performance, but would also provide the basis for further research on risk profile-tailored risk management strategies.

- **Compare and integrate explanatory models for IS project performance.** Although S4 examines the relative effects of project characteristics and governance mechanisms on IS project performance, structural relationships that explain how the risks associated with projects characteristics are mitigated by governance mechanisms with regard to their effect on IS project performance are not investigated within S4. A few such explanatory models are already proposed in extant IS project literature. However, they focus on different aspects and have so far not been integrated. For example, Barki, Rivard, and Talbot (2001) develop an integrative contingency model of software project risk management. The model hypothesizes that IS project performance is influenced by the project's risk and how project risk is managed. On the other hand, Nidumolu (1996c) develops a risk-based model of software project management. The model hypothesizes that standardized approaches to software development increase IS project performance. Identification, comparison, and subsequent integration of these explanatory models would help to better understand the interplay between risks and their mitigation mechanism and provide more informed explanations of IS project performance.

4 Conclusion

Motivated by the high failure rates reported for IS projects, the purpose of this thesis was to increase the understanding of how IS projects should be managed in order to increase IS project performance. This thesis contributes to IS project research by addressing four research challenges that have so far been limiting its understanding. (1) The empirical basis is enhanced by using meta-analytic techniques to aggregate the existing empirical evidence in IS project research. (2) Overgeneralized findings are differentiated by investigating differences between internal and outsourced IS projects, between client and vendor perspectives on outsourced IS projects, and between emerging and mature phases of the ITO industry. (3) The applicability of TCE and control theory for IS project research is investigated. (4) Fragmented research findings are integrated and compared. This thesis contributes to practice by providing guidelines for managing IS projects and relationships with outsourcing vendors. Since this thesis focuses on specific risks and governance mechanisms in its empirical analyses, future research is necessary to generalize the findings of this thesis to other risks and governance mechanisms. Further fruitful avenues for future research comprise benefits of IS project risk management, transmission of control portfolios through mixed market-based/hierarchical control chains, and the development of an "endogenous" ITO theory.

B Publications[3]

[3] The original publications have been slightly modified, including the unification of format and reference styles, the correction of spelling errors, and minor orthographical and grammatical revisions. To ensure consistent use of American English, S2 has been translated from British English to American English. Furthermore, the references included in each research study have been integrated and are presented at the end of this thesis. For this reasons, each of the meta-analytic studies (S2, S3, and S4) has been appendixed with a list of individual studies included in the meta-analytic calculations.

5 Transaction characteristics and risk estimations[4]

Title	Do vendors include transaction characteristics in their risk estimation? An empirical analysis of ERP projects
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Outlet	33rd International Conference on Information Systems 2012
Abstract	Using unique archival data on 81 projects from a major ERP vendor, we study whether transaction characteristics are included in the vendor's estimation of risk to project profitability. We hypothesize that project size, contract type, strategic importance, and client familiarity are included in the risk estimations. Regression analysis suggests that, surprisingly, vendors do not include all transaction characteristics in their risk estimation: While we found that larger projects and fixed price contracts are significantly associated with the vendor's risk estimation, strategic importance and client familiarity are not. Our data set also incorporates data on project profitability that presents us with the opportunity to test the efficiency of the risk estimation. We found that the vendor's risk estimation is efficient with regard to project size and contract type. Finally, the efficiency analysis also suggests that vendors deliberately accept profitability losses when conducting strategic projects.
Keywords	Outsourcing, ERP project, vendor perspective, risk estimation, profitability, transaction characteristics, strategic importance, client familiarity
Individual contribution	Ideation, hypotheses development, data preparation, data analysis, interpretation of results, and manuscript writing

Table 12. Bibliographic details for S1

[4] Originally published as: Hoermann, S., Dongus, K., Schermann, M., & Krcmar, H. (2012). *Do vendors include transaction characteristics in their risk estimation? An empirical analysis of ERP projects*. Paper presented at the 33rd International Conference on Information Systems, Orlando, FL.

5.1 Introduction

With a volume of 23.3 billion US dollars in 2011, outsourced Enterprise Resource Planning (ERP) projects account for a considerable share of outsourced information systems (IS) projects (Gartner Research, 2011). In outsourced ERP projects, vendors support clients in installing, parameterizing, integrating, testing, and upgrading pre-packaged ERP software (Aloini, Dulmin, & Mininno, 2007). In this context, the vendor's risk estimation associated with project profitability is important information to support the vendor in taking managerial decisions, such as designing contractual provisions and setting up the governance of the project (Gefen et al., 2008).

Prior research shows that transaction characteristics affect risk factors (Gemino et al., 2008; Wallace et al., 2004a; Yetton et al., 2000), project governance (Y. Chen & Bharadwaj, 2009a; Gefen et al., 2008; Kalnins & Mayer, 2004; J.-N. Lee & Kim, 1999; Poppo & Zenger, 2002), and project outcome (Gopal et al., 2003; Nam, Rajagopalan, Rao, & Chaudhury, 1996) of IS projects. However, little work has been published on the effect of transaction characteristics of outsourced IS projects on the vendor's risk estimation. Therefore, our research question is: *Do vendors include transaction characteristics in their risk estimation?* We hypothesize that project size, contract type, strategic importance, and client familiarity affect the vendor's estimation of risk to profitability. We test these hypotheses using a unique data set on 81 projects obtained from a major ERP vendor. In addition, our data set provides us with the opportunity to test whether the vendor's risk estimation is efficient with regard to information available on these transaction characteristics at the time of making the risk estimation.

Our analysis proceeds in two steps. First, we analyze the association between transaction characteristics and the vendor's risk estimation. Surprisingly, not all transaction characteristics are significantly associated with the vendor's risk estimation: While we found that larger projects and fixed price (FP) contracts are associated with higher risk estimations, we found no evidence to support an association between either strategic importance or client familiarity and the vendor's risk estimation. Second, following the approach suggested by Gopal et al. (2003), we test the efficiency of the risk estimation by regressing transaction characteristics and the vendor's estimation of risk to profitability. In the presence of the vendor's risk estimation, there seems to be no systematic effect of the two factors influencing the vendor's risk estimation, i.e., project size and contract type, on project profitability. Concerning the two factors not incorporated in the vendor's risk estimation, i.e., strategic importance and client familiarity, only strategic importance is significantly associated with lower project profitability.

Our findings suggest that the vendor does not include all transaction characteristics in its risk estimation: Information about project size and contract type is incorporated into the risk estimation, while information about strategic importance and client familiarity is not. Our findings also suggest that the vendor's risk estimation is efficient with respect to the two factors influencing it, i.e., project size and contract type: The vendor's risk estimation incorporates all information related to project size and contract type available to the vendor at the time of making the estimation. Because strategic importance is not included in the vendor's risk estimation but does have a significant negative effect on project profitability, we suggest that the vendor deliberately accepts lower project profitability when conducting strategic projects.

These results significantly contribute to the literature on outsourced IS projects. While it is accepted that project size, contract type, and client familiarity are important transaction characteristics of outsourced IS projects (Y. Chen & Bharadwaj, 2009a; Gefen et al., 2008; Gopal et al., 2003; Kalnins & Mayer, 2004), we know of no other study that empirically examines the effect of these transaction characteristics on the vendor's risk estimation. Furthermore, our analysis highlights the strategic importance of a project in determining project profitability, a relationship not previously discussed in this context in the literature.

The remainder of this paper proceeds as follows. In section 2, we present the conceptual background of our research. Section 3 presents and summarizes related work on the effect of transaction characteristics in outsourced IS projects. In section 4, we derive our hypotheses. Section 5 describes the research methodology. Section 6 introduces a model of project profitability to test for the efficiency of the vendor's risk estimation. In section 7, we discuss our results, study limitations, research contributions, and implications for practice. We provide our conclusive remarks in the paper's final section.

5.2 Related literature on transaction characteristics

Figure 7 depicts a commonly seen model of project outcome (e.g., Gemino et al., 2008; Wallace et al., 2004a; Yetton et al., 2000) in which project outcome is dependent on transaction characteristics, risk factors, and project governance. While transaction characteristics are knowable before the transaction takes place, risk factors and project governance evolve during the transaction. With regard to transaction characteristics, three associations have been of particular interest to researchers: the association between transaction characteristics and risk factors, the association between transaction characteristics and project governance, and the association between transaction characteristics and project outcome.

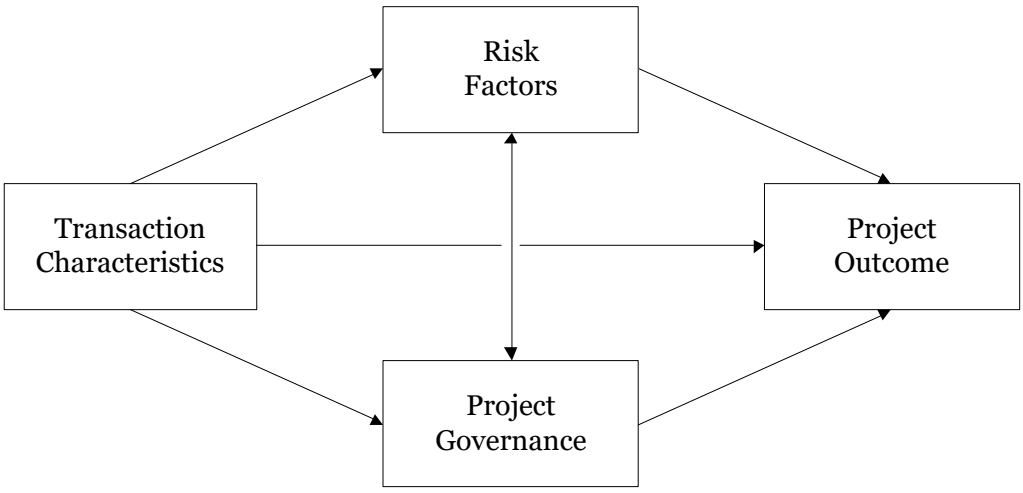

Figure 7. Related literature on transaction characteristics

Concerning the association between transaction characteristics and risk factors, researchers have acknowledged that risk factors evolve on the basis of transaction characteristics. For instance, Gemino et al. (2008) propose a temporal model of IS project outcome and find that transaction characteristics such as size or complexity are positively associated with emergent risk factors such as scope changes or project manager fluctuation. In a similar vein, Wallace et

al. (2004a) find that characteristics such as the use of new technology results in risk factors associated with project planning and control or the project team.

Concerning the association between transaction characteristics and relational project governance, a study by Poppo and Zenger (2002) investigated how prior relationships are related to relationship quality. Based on responses from 285 IS executives, the authors suggest that a more intense familiarity between client and vendor significantly improves relationship quality. Contrary to this, J.-N. Lee and Kim (1999) found no significant effect of a longer duration of client/vendor relationship on intention to continue the relationship. Gefen et al. (2008) examined how the contract type affects contractual project governance in the form of penalty provisions. Based on a sample of 274 outsourcing contracts, regression analysis suggested that fixed price contracts are associated with higher penalties. Y. Chen and Bharadwaj (2009a) extended these results by showing that prior relationships are also positively associated with the number of contractual provisions (property rights provisions, dispute resolution provisions, and contingency provisions). Prior relationships between client and vendor seem to be positively linked to contract extensiveness suggesting that prior experience leads to a better understanding of mutual requirements and capabilities which in turn allows the contracting parties to draft a more comprehensive contract (Y. Chen & Bharadwaj, 2009a).

Concerning the association between transaction characteristics and project outcome, Gopal et al. (2003) find that prior relationships, project size, and contract type are significantly associated with absolute vendor profits. Whereas larger projects and time and materials contracts seem to drive vendor profits, prior relationships have a negative effect. By showing that prior relationships are positively associated with the intention to continue risky projects, Nam et al. (1996) provide one possible reason for this negative effect of prior relationships on vendor profits.

Having access to a unique data set, we investigate whether vendors include transaction characteristics in their risk estimations and whether these estimations are efficient with regard to information available. In contrast to risk factors, transaction characteristics are knowable prior to a transaction and thus may be valuable indicators of a project's overall risk.

5.3 Conceptual background

In outsourced ERP projects, vendors support clients in installing, parameterizing, integrating, and testing pre-packaged ERP software or, after implementation, providing services such as maintaining, upgrading, or managing new releases (Aloini et al., 2007). We investigate the association between transaction characteristics of outsourced ERP projects and the vendor's risk estimation regarding project profitability. Figure 8 depicts a highly simplified representation of an outsourced ERP project from a vendor's perspective and illustrates events and information relevant to our research occurring at different points in time during the project.

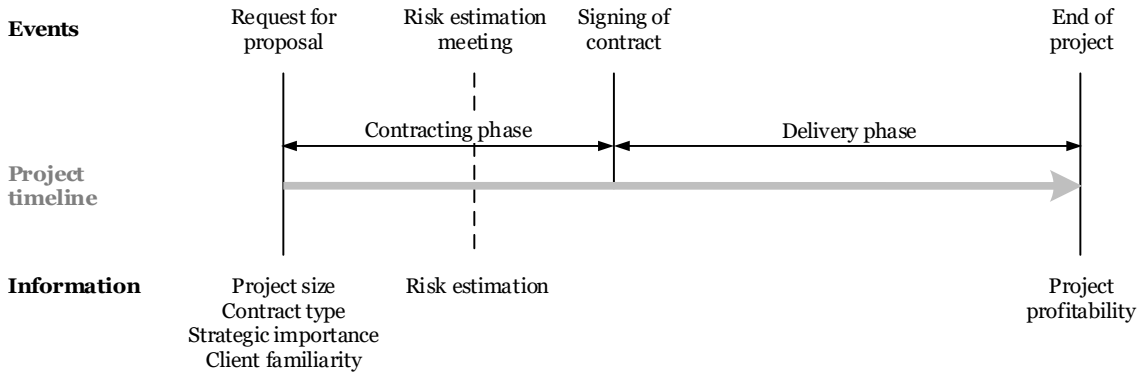

Figure 8. Timeline of relevant events and information during an ERP project

From a vendor's perspective, a project starts with the client issuing a request for proposal (RFP). Besides the requested scope of the project, the RFP conveys information about the volume of the project and the client's preference for contract type (Gefen et al., 2008). The project volume indicates the estimated effort required for project completion and is a reasonable indicator for the size of a project (Sauer et al., 2007). While the project's contract type is in theory the outcome of a contracting phase where both parties evaluate the risks and benefits associated with different contract types, the contract type is in practice often predetermined by the client in the RFP and not subject to negotiation during the contracting phase. There are two major types of contracts in outsourced IS projects: fixed price (FP) and time and materials (TM) contracts (Banerjee & Duflo, 2000). While variations such as capped price (CP) contracts exist, FP and TM contracts are most common (Gopal et al., 2003). In FP contracts, the vendor agrees to deliver the project as specified by the client for a predefined price. In TM contracts, the vendor is paid on an hourly basis based on agreed rates. The vendor's revenues (and the client's costs, respectively) are not predetermined at the time of contract closure in TM contracts (Kalnins & Mayer, 2004).

Beyond the explicitly stated information on project volume and contract type, the vendor evaluates client familiarity which refers to its knowledge about the client and the client's trustworthiness based on prior relationships (Gefen et al., 2008; Gulati, 1995). Using all collected information, the vendor decides if the project is of strategic importance in addition to the project's financial objectives. The strategic importance of the project to the vendor is reflected in objectives such as winning an important reference client, entering a new market, introducing a new technology, or establishing long-term relationships with the client.

This initial understanding of the transaction characteristics of the project marks the starting point of the contracting phase. One important event occurring during the contracting phase is the risk estimation meeting the purpose of which is to estimate the profitability risk of a project. The vendor's risk estimation provides information to support managerial decisions made later during the contracting phase (Gefen et al., 2008).

The signing of the contract marks the end of the contracting phase and the beginning of the delivery phase during which the vendor supports the client in implementation or post-implementation activities. At the end of the project, the vendor should be able to calculate project profitability by dividing project profits by project revenues.

5.4 Research hypotheses

Figure 9 gives an overview of our research hypotheses on how vendors include transaction characteristics in their risk estimations.

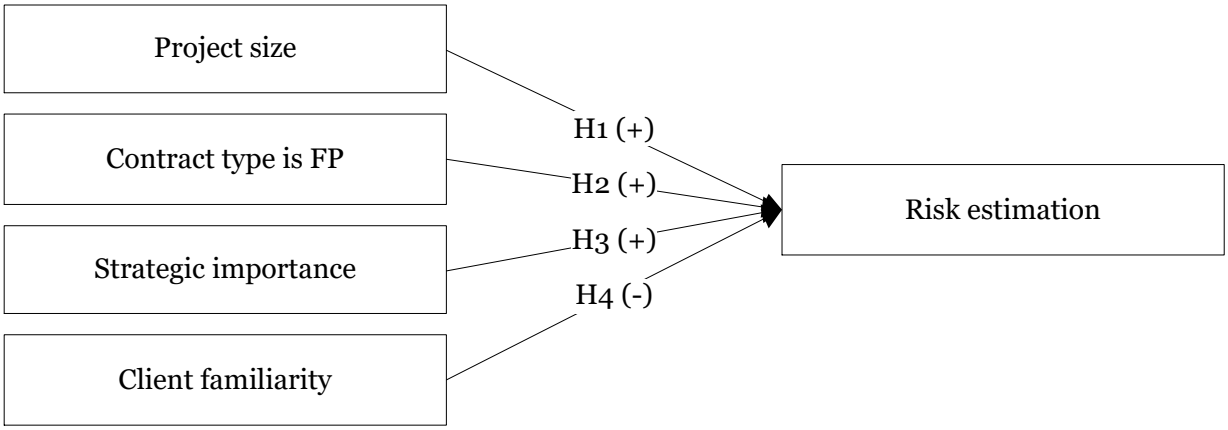

Figure 9. Research model

Project size has been identified as an important determinant of IS project risk (McFarlan, 1981) and subsequent empirical evidence has substantiated this claim. Similar to arguments presented by Yetton et al. (2000), Gemino et al. (2008) also argue that project size increases complexity and task interdependence as well as volatility in IS projects and, thus, negatively affects performance. In their analysis of the effect of four components of project size (effort, duration, volume, team size) on project performance, Sauer et al. (2007) add that the link between size and performance may not be as direct as commonly thought. Their results suggest that: a) regardless of project size a baseline risk exists, b) the various components of size affect performance in a different way, and c) an increase in project size does not necessarily increase the risk of underperformance. Despite these restrictions we argue that larger projects tend to be more difficult to plan and to control and, due to their size, bear greater financial risk for the vendor. Consequently, we hypothesize:

Hypothesis 1 (H1): Larger projects are associated with higher risk estimation.

Formal contracting is an important aspect of client vendor relationships in outsourced IS projects. A formal contract represents "written contractual and management-initiated mechanisms designed to guide behavior toward desired objectives" (Goo et al., 2009). Formal contracts determine how risks are shared between vendor and client (Lacity & Hirschheim, 1993), have an impact on how projects are managed (Gopal & Sivaramakrishnan, 2008), and affect project outcome (Ramachandran & Gopal, 2010). In FP contracts, the risk of budget and schedule overruns is borne by the vendor, in TM contracts by the client. Furthermore, although in theory FP contracts offer the vendor the chance to leverage information asymmetries and, thus, achieve higher profitability, average vendor profits seem to be higher in TM contracts (Gopal et al., 2003). With this in mind, we suggest that FP contracts increase the vendor's risk estimation:

Hypothesis 2 (H2): Fixed price contracts are associated with higher risk estimation.

Investigating the determinants of IS project performance, Yetton et al. (2000) find empirical evidence that risk is a function of the strategic importance of a project. Following Yetton et al. (2000), we conceptualize strategic projects as business-critical projects with other than short-term financial objectives. For instance, vendors may conduct strategic projects in order to win important reference clients, to enter new markets, to test new technologies, or to generate follow-up projects. In these cases – though still important – financial success becomes a second priority. Due to their high visibility in the market, failing to successfully deliver strategic projects may cause long-term damage to reputation and affect the vendor's future business potential. In addition, because of the high criticality of strategic projects, the vendor might be more likely to make concessions during the contracting phase, resulting in more unfavorable terms and conditions. Both factors should drive the vendor's risk estimation. Thus, we hypothesize:

Hypothesis 3 (H3): Strategic projects are associated with higher risk estimation.

In their study on risk mitigation in outsourced IS projects, Gefen et al. (2008) suggest that familiarity may reduce risk in client vendor relationships. According to Gefen et al. (2008), familiarity may influence risk through two aspects, knowledge and trust. The authors argue that the knowledge-related aspect of familiarity reduces information asymmetries and, consequently, risk during the contracting phase (Gefen et al., 2008). Through repetitive partnerships, client and vendor get to know each other's capabilities, business environments, and cultures, which facilitates more exact estimation of cost and better allocation of resources (Kalnins & Mayer, 2004). The trust-related aspect that evolves from familiarity is important as it facilitates cooperation between client and vendor during the delivery phase of the project (Gefen et al., 2008). Trust increases the chance that both parties will take constructive steps towards achieving common goals and reduces opportunistic behavior and the need for control (Gulati, 1995). Both the knowledge- and trust-related aspect of familiarity seem to be particularly valuable in ERP projects because these projects are typically knowledge-intensive and require considerable cooperation between client and vendor (Markus & Tanis, 2000). Thus, we hypothesize:

Hypothesis 4 (H4): Greater client familiarity is associated with lower risk estimation.

5.5 Methodological approach

5.5.1 Research site and data collection

Our industry partner ALPHA is a major vendor in the ERP software market. ALPHA develops and distributes its software and offers implementation and post-implementation services to clients from a broad range of industries. These services are organized as projects.

Project risk management at ALPHA is an integral part of the project management process. The primary goal of project risk management is to promote successful projects with a focus on project profitability. To this end, an independent organizational risk management unit supervises projects exceeding a volume threshold of € 250,000. The objectives of risk management at ALPHA comprise: (a) early detection of project risks, (b) providing transparency on risks to internal project stakeholders, and (c) control and mitigation of risks to keep additional costs at a minimum.

Variables	Descriptions	Unit / scale	Mean (SD)	Min	Max
Project size	The estimated volume of the project as stated in the RFP (Sauer et al., 2007)	‘000s, €	2,234.47 (3,787.28)	81	22,200
Contract type	Indicator of whether the contract type is FP (0) or TM (1)	Binary variable	0.37 -	0	1
Strategic importance	Indicator of whether the project is of strategic importance (1) or not (0)	Binary variable	0.60 -	0	1
Client familiarity	Familiarity between client and vendor as indicated by the number of prior projects with the same client (Gefen et al., 2008)	Number of prior projects	2.21 (3.03)	0	15
Project duration	Actual duration of the project in days between the signing of the contract and the end of the project	Number of days	417.5 (309.8)	60	1,705
Risk estimation	Indicator of whether the project is classified as low (1), medium (2), or high (3) risk project	3-point scale	1.40 (0.54)	1	3
Project profitability	Project profits divided by project revenues	Percent	29 (20)	-84	61

Notes. SD: standard deviation.

Table 13. Variable descriptions and descriptive statistics

In projects that are subject to ALPHA’s project risk management, a risk estimation meeting takes place during the contracting phase (Figure 8). The risk estimation meeting follows standard risk management practices as proposed by Boehm (1991) or Charette (1996) and comprises identification, assessment, control, and monitoring of project risks. Risk estimation meetings are initiated and moderated by the independent risk management unit. Participants come from various organizational units such as finance and accounting, project management, or legal. Depending on the circumstances, the review meeting is either held via telephone or in person. In either case, the risk estimation meeting is guided by a standardized spreadsheet, which captures transaction characteristics and other risk relevant information about the project. It includes the client’s name and industry, a one-paragraph project summary, ALPHA’s project objectives, the contract type, and the project volume in Euro. The risk estimation is established by classifying the project as low, medium, or high risk. Most importantly, this risk estimation does not express an individual opinion but rather reflects the results of a systematic group

discussion in the risk estimation meeting. The vendor's risk estimation serves as an important management reporting tool in regular internal steering committee meetings.

We tested our hypotheses on data from 81 ERP projects completed by ALPHA between 2005 and 2010 and exceeding € 250,000[5]. Thus, these projects were subject to the supervision by the independent risk management unit as described above. In total, risk estimation meeting spreadsheets from 923 projects were available for our study. As the 923 projects contained projects, which were still in various planning phases or ongoing, we narrowed our data set to 81 completed projects. The risk estimation meeting spreadsheets of these 81 projects provided the basis for our analysis. Our projects stem from 65 different clients spanning a broad range of industries with a focus on automobile and components (12 projects), banks (11 projects), utilities (11 projects), and capital goods (8 projects). Variable descriptions and descriptive statistics are shown in Table 13.

The project volume in Euro was extracted as explicitly stated in the risk estimation meeting spreadsheet as was the contract type (FP or TM) and the vendor's risk estimation (high, medium, or low). With regard to contract type, CP contracts were coded as FP contracts as they also put an upper limit on the project's volume. These characteristics were explicitly stated in the spreadsheets and, thus, were not subject to our interpretation.

A project's strategic importance to the vendor was assessed separately by two authors based on ALPHA's project objectives and the project summary as recorded on the spreadsheet. For each project, ALPHA recorded up to three project objectives ordered by descending priority. Projects were coded as being strategic if, for example, ALPHA aimed at winning back a client from a competitor, entering a new market, or acquiring follow-up projects. In the case of contradictory objectives, we used the primary objective to code the project. Coding examples can be found in the appendix (Table 17). After both authors completed the coding, we used Cohen's Kappa (Cohen, 1960) to determine inter-rater reliability. Following the labels attached by Landis and Koch (1977), our initial Cohen's Kappa of 0.62 indicated "substantial" agreement among the authors. The 15 disagreements between the first and the second author could easily be resolved in a second round of coding. In addition, we clarified our coding scheme in a post-hoc discussion with our industry partner. While the industry partner was positive about the coding scheme in general, it was noted that the project objectives are usually entered by the bid team into the risk estimation meeting spreadsheet and, thus, may represent its specific perspective on the project.

We followed the suggestion by Gefen et al. (2008) and calculated client familiarity as the number of previous projects ALPHA had with the client at the time of conducting a given project. As we did not have access to projects conducted prior to 2005, our measure should be seen as a lower boundary of client familiarity. Thus, in order to mitigate the bias that inevitably results from this temporal restriction, we took all 923 projects into account when calculating client familiarity (Gefen et al., 2008).

To test for the efficiency of the vendor's risk estimation, we collected financial data including all revenues and expenses accumulated during the project and the dates of all orders related to

[5] Two projects in our sample are below this threshold with a project volume of € 81,000 and € 100,000, respectively. As these projects, with the exception of their low volume, do not feature any peculiar characteristics, we kept them in our sample.

the project. Using this approach, common method bias is minimized as revenues and expenses stem from a different data source than the transaction characteristics (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Project profitability was calculated as the share of total project profits, i.e., total project revenues minus total project expenses, on total project revenue. Notably and in contrast to Gopal et al. (2003), we are able to calculate relative instead of absolute project profits and, thus, provide a more accurate picture of vendor profitability. Project duration was calculated as the number of days between the signing of the contract and the end of the project.

5.5.2 Data analysis

Our hypotheses were tested using the following ordered probit specification[6]:

$$vendor\ risk\ estimate_i = \beta_1 \log(project\ size_i) + \beta_2\ contract\ type_i + \beta_3 strategic\ importance_i + \beta_4 \log(client\ familiarity_i + 1) + \varepsilon_i$$

where i indexes the individual projects and ε_i is an error term. Based on the variable distributions, we transformed project size and client familiarity by taking the logarithm. This transformation is a common procedure in empirical IS research to reduce the skewness of variables (e.g., Gefen et al., 2008; Rai, Pavlou, Im, & Du, 2012; Ramasubbu et al., 2008).

The specification was estimated using maximum likelihood. Because the error terms may not be independent as some clients engaged in multiple projects, we clustered the error terms by client. We tested for influential observations using Cook's distance and identified six observations as outliers according to the upper threshold of $4/n$ recommended by L. Hamilton (2006). Estimation results are shown in Table 14 and clustered standard errors are given in parentheses. The relationship of transaction characteristics and risk estimations using the full sample size and the results for the outlier-corrected sample are presented in the table. To test for multicollinearity we calculated the variance inflation factors (VIF) for each independent variable. The highest VIF was 1.17, which is lower than the recommended upper threshold of 10 (Hair et al., 2006), indicating acceptable multicollinearity. There was no significant endogeneity[7].

Concerning the model estimated on the full sample, a chi-square of 13.10 and a Pseudo-R^2 of 0.17 indicate a good fit of the overall model, which is significant at $p < 0.05$. The results provide strong support for our hypotheses H1 (*Larger projects are associated with higher estimations of risk*) and H2 (*Fixed price contracts are associated with higher estimations of risk*). Strategic importance and client familiarity seem to have no effect on the vendor's risk estimation, not supporting H3 and H4, respectively. The model estimated on the outlier-corrected sample

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[6] As an additional robustness check, we also estimated the model using an ordinary least squares specification. The results were consistent with those of the ordered probit specification depicted in Table 14.

[7] As suggested by Gopal and Sivaramakrishnan (2008) and Gopal et al. (2003), one candidate for endogeneity would appear to be contract type. To test for endogeneity, we used Heckman's two stage procedure (Heckman, 1979) as outlined in B. Hamilton and Nickerson (2003). In the first stage, a probit specification was used to assess the effects of project size, strategic importance, and client familiarity on contract type. Based on these results, we calculated the inverse Mill's ratio. In the second stage, the vendor's risk estimate was estimated as a function of project size, contract type, strategic importance, and client familiarity, as well as the inverse Mill's ratio as an additional variable. The inverse Mill's ratio was not significant indicating no significant endogeneity (Shaver, 1998).

produces even greater effect sizes and significance levels for project size and contract type, indicating robustness of the results.

Variables	**Full sample** $(n = 81)$	**Outlier-corrected sample** $(n = 74)$
log(Project size)	0.563*** (0.187)	1.026*** (0.240)
Contract type	-0.875*** (0.315)	-1.480*** (0.409)
Strategic importance	-0.143 (0.263)	-0.048 (0.335)
log(Client familiarity + 1)	-0.900 (0.240)	-0.396 (0.260)
Log likelihood	-50.66	-34.19
Chi-square	13.10**	23.81***
d.f.	4	4
Pseudo-R^2	0.17	0.18

Notes. d.f.: degrees of freedom; ***: significant at the 1% level, **: significant at the 5% level, *: significant at the 10% level, for two-tailed tests; clustered standard errors are in parentheses.

Table 14. Transaction characteristics and the vendor's risk estimation, ordered probit models

5.6 Efficiency-test of the vendor's risk estimation

Our data set presents us with the unique opportunity to test the efficiency of ALPHA's risk estimation. In this context, the risk estimation of ALPHA is said to be efficient with regard to the transaction characteristics if it incorporates all information related to the transaction characteristics available to ALPHA at the time of estimation. Following the econometric framework outlined in Gopal et al. (2003), any deviation in realized project profitability should result from contingencies that are unanticipated and, thus, not incorporated in ALPHA's risk estimation. Therefore, we hypothesize that in the presence of the vendor's risk estimation there should be no significant effect of the variables representing the transaction characteristics known at the time of estimation. We used the following linear specification to test this efficiency hypothesis:

$$\begin{aligned} project\ profitability_i \;=\; & \beta_0 + \beta_1 \log(project\ duration_i) + \beta_2\, vendor\ risk\ estimate_i \\ & + \beta_3 \log(project\ size_i) + \beta_4\, contract\ type_i + \beta_5 strategic\ importance_i \\ & + \beta_6 \log(client\ familiarity_i + 1) + \varepsilon_i \end{aligned}$$

where i indexes the individual projects and ε_i is an error term. Following Gopal et al. (2003) we included the actual project duration, representing an ex-post "performance" variable, in the

model to add power to the tests. We again used logarithmic transformations to reduce the skewness of the variables project duration, project size, and client familiarity. The specification was estimated using ordinary least squares. As outlined in the preceding section, we clustered the error terms by client. Using Cook's distance for this model, we identified three observations as outliers according to the upper threshold of $4/n$ recommended by L. Hamilton (2006). Estimation results are shown in Table 15 and clustered standard errors are given in parentheses. The effects of project duration, transaction characteristics and risk estimations on realized project profitability using the full sample size and the results for the outlier-corrected sample are presented in the table. To test for multicollinearity, we calculated the VIF for each independent variable. The highest VIF was 1.47, which is lower than the recommended upper threshold of 10 (Hair et al., 2006), indicating acceptable multicollinearity. There was no significant endogeneity[8].

Variables	**Full sample ($n = 81$)**	**Outlier-corrected sample ($n = 78$)**
log(Project duration)	-4.898 (3.617)	-3.249 (2.224)
Risk estimation	-12.109** (5.538)	-5.365** (2.359)
log(Project size)	-1.900 (1.810)	-1.370 (1.326)
Contract type	0.776 (3.946)	0.192 (2.929)
Strategic importance	-9.107** (3.733)	-5.324** (2.640)
log(Client familiarity + 1)	0.682 (2.316)	0.766 (1.475)
Constant	105.327** (41.667)	79.659*** (24.563)
F	1.62	2.29**
d.f.	6, 64	6, 61
R^2	0.27	0.22

Notes. d.f.: degrees of freedom; ***: significant at the 1% level, **: significant at the 5% level, *: significant at the 10% level, for two-tailed tests; clustered standard errors are in parentheses.

Table 15. Efficiency test of the vendor's risk estimation, ordinary linear models

[8] As described above, we tested contract type for endogeneity using Heckman's two stage procedure (Heckman, 1979) The inverse Mill's ratio was again not significant indicating no significant endogeneity (Shaver, 1998).

Concerning the model estimated on the full sample, a R^2 of 0.27 indicates a good fit. In presence of ALPHA's risk estimation, project size, contract type and client familiarity seem to have no effect on project profitability. A higher risk estimation and projects with strategic importance to the vendor are significantly associated with lower project profitability. Overall, the results indicate that the vendor's risk estimation is efficient with regard to project size and contract type. The model estimated on the outlier-corrected sample produces lower effect sizes for the risk estimation and strategic importance but is consistent with the results obtained using the full sample which indicates robustness of the results.

5.7 Discussion

5.7.1 Summary of results

The underlying rationale of our study was to examine whether vendors include transaction characteristics in their risk estimations. Using a unique archival data set of 81 projects from a major ERP vendor, our results show that not all of the four investigated transaction characteristics are included in the vendor's risk estimations. While larger projects and fixed price contracts are significantly associated with higher estimations of risk, lending support to H1 (*Larger projects are associated with higher estimations of risk*) and H2 (*Fixed price contracts are associated with higher estimations of risk*), strategic importance and client familiarity are not included, not supporting H3 (*Strategic projects are associated with higher estimations of risk*) and H4 (*Greater client familiarity is associated with lower estimations of risk*), respectively.

Given that project size has been shown to correlate with complexity, volatility, and task interdependence (Gemino et al., 2008; Yetton et al., 2000), and fixed price contracts transfer the risk of budget overruns to the vendor (Banerjee & Duflo, 2000; Ethiraj et al., 2005; Gopal et al., 2003) respectively, it is not surprising that risk managers at ALPHA regard these characteristics as important threats to profitability.

With regard to strategic importance and client familiarity, our findings are more surprising: While Yetton et al. (2000) suggest that strategic importance is positively associated with risk, our results show that strategic importance is not included in the vendor's risk estimations. We argue that when pursuing strategic goals, such as winning reference clients or entering new markets, vendors deliberately accept lower project profitability. Thus, the effect of strategic importance on project profitability is compensated for and subsequently not part of the vendor's risk estimations.

Concerning client familiarity, Gefen et al. (2008) argue that familiarity between clients and vendors in outsourced IS projects mitigates risk through increased knowledge and trust. Interestingly and contrary to the reasoning presented in Gefen et al. (2008), we found that client familiarity is not significantly associated with lower estimations of risk. One possible reason for this is that knowledge gained from increased familiarity is not directly reflected in the vendor's risk estimation but rather affects how future relationships are managed in terms of contractual governance. This is in line with empirical evidence presented in Kalnins and Mayer (2004) and Gopal et al. (2003). Post-hoc interviews substantiated this line of argumentation: ALPHA risk managers are primarily concerned with project profitability, which is a matter of

contractual governance and, thus, not impacted by the degree of familiarity between vendor and client.

Our data set incorporated ex-post data on profitability that presented us with the unique opportunity to test the efficiency of the vendor's risk estimation. Efficiency of the vendor's risk estimation implies that the risk estimation incorporates all available information that relates to the transaction characteristics included in the risk estimation, i.e., project size and contract type, and that is known at the time of estimation. The efficiency test substantiates this hypothesis with regard to these two transaction characteristics. In the presence of the vendor's risk estimation, both transaction characteristics do not significantly affect profitability.

The efficiency test also shows that strategic projects are significantly associated with lower project profitability. In line with this, post-hoc interviews substantiated the notion that ALPHA is willing to accept profitability losses in the case of strategic projects.

5.7.2 Limitations

Our study is subject to several limitations. Firstly, because we analyzed data from one company only, there may be issues concerning the representativeness of our results. ALPHA's organizational context may not be comparable to other companies that provide ERP implementation and post-implementation services. In this regard, particularly the fact that ALPHA does not only offer services to its clients but also develops and distributes its own ERP software differentiates ALPHA from other ERP service providers. However, we argue that this organizational difference does not affect the generalizability of our findings. We can think of no reason why the nature of the associations between project size, contract type, client familiarity, strategic importance and the risk estimation should change for other ERP service providers. Solely, ALPHA's conceptualization for strategic importance may differ from those of other ERP service providers. For instance, ALPHA may also consider service projects as strategic that are primarily conducted in order to sell software licenses.

Secondly, data are only available for projects exceeding € 250,000 and, thus, supervised by ALPHA's risk management unit. Our sample is therefore slightly biased towards larger projects. Because of the considerable costs associated with a formal risk management process, the practical implications of our paper may not be applicable to smaller projects.

Thirdly, this study examined outsourced ERP projects as a specific type of outsourced IS projects. Amongst other things, ERP projects are specific with regard to their high degree of client-vendor interaction and organizational change, the need to integrate with legacy systems, and the deployment of pre-packaged software (Markus & Tanis, 2000). Hence, generalization to other types of IS projects, such as outsourced software development projects, may require additional research.

Fourthly, the set of transaction characteristics that are included in this study is restricted by the information given in ALPHA's archival data set. Notwithstanding that we have included heavily discussed transaction characteristics in the IS literature such as project size, contract type, and client familiarity, our set of transaction characteristics is not theoretically complete and important transaction characteristics such as task complexity and asset specificity are missing. However, as our research objective was to analyze weather vendors include transaction characteristics in their risk estimation, theoretical completeness of the transaction

characteristics is not absolutely essential. Nevertheless, since our analysis revealed that vendors do not include all transaction characteristics in their risk estimation, future research should investigate the inclusion of further transaction characteristics.

Fifthly, as discussed in the data collection section, the project objectives based on which the projects' strategic importance is coded are entered by the bid team that negotiates the project contracts. Post-hoc interviews with ALPHA risk managers revealed that this perspective may in some cases differ from the projects' actual strategic importance: The bid team may overstate the strategic importance in order to justify poorly negotiated contracts with low profitability prospects. This case offers an alternative explanation for our results: Being aware of the bid team's behavior, risk managers would not incorporate the bid team's perspective on a project's strategic importance into their risk estimation. Also, poorly negotiated contracts with an overstated strategic importance would drive the association between strategic importance and lower project profitability. In a subsequent study, we will clarify this issue by having ALPHA's risk managers code the projects' strategic importance, providing us with an additional perspective.

Finally, our results were dependent on the quality of ALPHA's archival data. As risk management is often seen as a burden which creates 'extra work and expense' (Verner & Evanco, 2005), the possibility exists that the risk estimation meeting spreadsheets were not carefully maintained by the risk managers, although we found no evidence to support this suspicion. Instead, our post-hoc interviews highlighted the considerable value ALPHA attributes to the risk management process in general and the risk estimation in particular. In addition, the comprehensiveness of comments provided in the free text fields in the spreadsheets suggests a reasonably high quality of data. Other authors explicitly emphasize the value of comprehensive archival data (Ropponen & Lyytinen, 1997), which may be better suited for investigating perceptional data than surveys or interviews due to the avoidance of recall bias (T. Mitchell & Thompson, 1994).

5.7.3 Contributions to research

We see two major contributions to research. First, our study is one of the first attempts to empirically analyze transaction characteristics that shape the vendor's risk estimation in the context of outsourced ERP projects. There is considerable research on transaction characteristics and their effect on risk factors (Gemino et al., 2008; Wallace et al., 2004a; Yetton et al., 2000), project governance (Y. Chen & Bharadwaj, 2009a; Gefen et al., 2008; Gopal et al., 2003; Kalnins & Mayer, 2004; J.-N. Lee & Kim, 1999; Poppo & Zenger, 2002), and project outcome (Gopal et al., 2003; Nam et al., 1996). This study adds the vendor's risk estimation as another important aspect affected by transaction characteristics. Furthermore, we tested the efficiency of the vendor's risk estimation by investigating the effect of transaction characteristics and the risk estimation on project profitability.

The second contribution of our research is that we highlight the strategic importance of projects from a vendor's perspective as an important construct in the context of client-vendor relationships. Strategic importance indicates that objectives such as winning important reference clients, entering new markets, testing new technologies, or generating follow-up projects are vital for vendors. Our results substantiate the notion of 'must-have projects' and strategic vendor behavior. To the best of our knowledge, prior research on outsourced IS

projects has only partially addressed strategic importance by focusing on aspects such as future business potential (Gopal et al., 2003).

The value of these contributions is substantiated by the unique archival data set on which our analysis is based. Previous studies on outsourced IS projects mainly relied on post-hoc surveys. Using archival data potentially rules out common method bias (Podsakoff et al., 2003) and may provide better estimations of path coefficients and explained variance (Gefen et al., 2008). Some authors have examined archival data similar to ours (Gefen et al., 2008; Kalnins & Mayer, 2004) from either a client perspective or not in the context of outsourced ERP projects. To the best of our knowledge, this is the first time that vendor profitability was analyzed in terms of the realized margin instead of absolute profits (Gopal & Sivaramakrishnan, 2008; Gopal et al., 2003) or perceptional measures (Ramachandran & Gopal, 2010). Our data set also provided us with the opportunity to assess strategic importance as indicated by ALPHA's project objectives.

5.7.4 Implications for practice

Our results suggest that project size and contract type are central constituents of the vendor's risk estimation. For vendors, larger projects and fixed price contracts seem to bear more risk. Given ALPHA's overall success in the market, IT managers at other vendors may find it useful to emphasize these aspects when estimating project risk.

The efficiency of the vendor's risk estimation implies that the vendor seems to have a good intuition about risks that stem from project size and contract type. As in ALPHA's case successful managerial decisions were based on the risk estimation, our analysis may serve as an illustration of the potential benefits of formal project risk management (Boehm, 1991; Charette, 1996). This finding may be valuable for other IS project vendors who think about introducing formal risk management.

Finally, our findings provide evidence for strategic vendor behavior during the contracting phase. Although our analysis does not allow us to judge ALPHA's priority concerning the respective strategic objectives, it becomes clear that ALPHA deliberately relaxes profitability requirements when strategic considerations come into play. Again, given ALPHA's overall success in the market, this finding highlights the importance of objectives, other than financial ones, and long-term orientation for IS project vendors.

5.8 Conclusion

Based on the analysis of 81 outsourced ERP projects, we sought to answer the research question: *Do vendors include transaction characteristics in their risk estimations?* Therefore, we related transaction characteristics to the vendor's risk estimation. Notably, our results show that not all transaction characteristics are included in the vendor's risk estimation. While we found that larger projects and fixed price contracts are included in the vendor's risk estimation, strategic importance and client familiarity are not. Furthermore, we tested the efficiency of the vendor's risk estimation by linking it to project profitability. Our findings suggest that the vendor's risk estimation is efficient with regard to the two characteristics included in the risk estimation, i.e., project size and contract type.

Finally, we found that strategic importance significantly affects project profitability but is not included in the vendor's risk estimation. This suggests that in strategic projects, vendors deliberately accept lower project profitability and adjust their margin requirements prior to estimating project risk. Future research should look into this particular transaction characteristic in more detail. The investigation of various strategic objectives and how much profitability loss the vendor is willing to take seems especially promising.

5.9 Appendix

Variable	(1)	(2)	(3)	(4)	(5)	(6)
(1) Client familiarity	1.000					
(2) Contract type	-0.151	1.000				
(3) Project size	-0.155	0.252**	1.000			
(4) Strategic importance	-0.019	-0.008	0.258**	1.000		
(5) Risk estimation	-0.087	-0.183	0.387***	0.077	1.000	
(6) Project profitability	0.094	0.054	-0.286**	-0.273**	-0.412***	1.000
(7) Project duration	-0.119	-0.031	-0.008	-0.009	0.141	-0.224**

Notes. ***: significant at the 1% level, **: significant at the 5% level, *: significant at the 10% level, for two-tailed tests.

Table 16. Correlation matrix

Level	Description	Examples
0	Non-strategic projects as characterized as business-by the following keywords in ALPHA project objectives or project summary: revenue, profitability, commercial goals, and utilization.	"Revenues and contribution" "Generate revenues with a margin above x% and utilize associates" "Financial success"
1	Strategic projects as characterized by the following keywords in ALPHA project objectives or project summary: market entrance, market development, reference client, win-back, lighthouse project, follow-up projects, product development, and reputation.	"Lighthouse project in the healthcare industry, potential role model for other clients" "Strategic positioning for larger projects" "Securing a considerable license deal"

Table 17. Coding scheme for strategic importance

6 TCE and ITO industry maturity[9]

Title	Transaction cost economics and industry maturity in IT outsourcing: A meta-analysis of contract type choice
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Abstract	Recent reviews of the information technology outsourcing (ITO) literature report high variance in research results when transaction cost economics (TCE) is used as the analytical framework. Informed by ITO market developments, including increasing commoditization, market consolidation, and market transparency, we develop an explanation for these mixed results contingent on ITO industry maturity. We adopt meta-analysis to show that ITO industry maturity significantly explains variance in the choice of contract type (time and materials vs. fixed price) in ITO projects. Our results suggest that TCE is relevant to explain the choice of contract type in the emerging phase of the ITO industry, but not in its current mature phase. We conclude that a TCE-based analytical framework is not well suited for the study of ITO in the current mature industry phase. Instead, we propose that an "endogenous" ITO theory should be developed that focuses on differences in client behavior rather than vendor behavior.
Keywords	Transaction cost economics, IT outsourcing, industry maturity, meta-analysis, contract type
Individual contribution	Ideation, hypotheses development, data preparation, data analysis, interpretation of results, and manuscript writing

Table 18. Bibliographic details for S2

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6.1 Introduction

Starting in the 1990s, information technology outsourcing (ITO) has developed into a well-established global industry with an estimated market volume of US$ 287 billion in 2013 (Britz et al., 2013). Following Grover, Cheon, and Teng (1996), we define ITO as "a service provided by an external vendor that could involve various facets of a firm's IT development, operations, and management" (p. 93). This definition includes, for example, software development, IT infrastructure, and software-as-a-service outsourcing.

ITO services are becoming standardized and modularized, allowing ITO vendors to realize economies of scale (Manning, 2013). At the same time, the ITO industry has become increasingly consolidated and competitive (Manning, Lewin, & Schuerch, 2011). ITO clients are becoming more informed due to increased market transparency contingent on the standardization of ITO services and consolidation in the ITO market (Reimann, Schilke, & Thomas, 2010).

Critical ITO decisions in both theory and practice include the decision to make or buy (e.g., Watjatrakul, 2005), the degree of outsourcing (e.g., Aubert, Rivard, & Patry, 2004), and ITO management decisions, for example, choice of contract type (e.g., Susarla et al., 2009) and trade-offs between relational and formal governance (e.g., Poppo & Zenger, 2002). Across this literature, transaction cost economics (TCE), in which the transaction is the unit of analysis (Williamson, 1979, 1985), is the dominant analytical framework (Dibbern et al., 2004; Karimi-Alaghehband et al., 2011; H. K. Klein, 2002; Lacity et al., 2011).

However, the empirical findings reported in the ITO literature do not strongly support the TCE logic. Instead, there is high variance in effect sizes and even in the direction of those effects (Karimi-Alaghehband et al., 2011; Lacity et al., 2011). Reviewing ITO studies on the decision to outsource and related outcomes, Karimi-Alaghehband et al. (2011) report that 44% of TCE-based hypotheses were not supported. In a similar literature analysis, Lacity et al. (2011) find that 51% of the TCE-based hypotheses, explaining a wide variety of ITO decisions and outcomes, are not supported.

Two different explanations are proposed for these empirical findings. One is methodological. Karimi-Alaghehband et al. (2011) argue that measurement errors and construct validity threats explain the variance in findings. The other explanation is theoretical. Lacity et al. (2011) conclude that the variance in findings is the result of an uncritical and inappropriate adoption of the TCE framework.

In this paper, we propose and investigate a third explanation, which combines elements from both Karimi-Alaghehband et al. (2011) and Lacity et al. (2011). The argument has two components. One is that, in the strategic management literature, Argyres and Bigelow (2007) argue that the applicability of TCE and, hence, the explanatory power of TCE, is a function of the maturity of an industry.

The other component is the finding from the ITO literature that market developments, such as increasing commoditization, consolidation, and market transparency, have changed the ITO industry (Manning, 2013; Manning et al., 2011). Specifically, the ITO industry has changed from an emerging industry and became a mature industry (Bhatnagar & Madon, 1997; Stadtmann & Kreutter, 2009; Suarez, Cusumano, & Kahl, 2013). Hence, the question guiding

this research is: *Does the maturity of the ITO industry explain the variance in TCE-based findings for the effect of uncertainty on the choice between fixed price contracts, and time and materials contracts?*

Meta-analysis is adopted to investigate this question. Specifically, we compare the explanatory power of the TCE analytical framework in the initial emerging phase compared with the more recent maturing phase of the ITO industry. To do this, we restrict the analysis to the choice of contract type, specifically, the choice between a time and materials (TM) contract and a fixed price (FP) contract.

The choice of contract type was investigated because it satisfies three criteria. First, it is an important research issue. It has been the subject of a major research stream in the ITO literature (Fink, Lichtenstein, & Wyss, 2013; Gefen et al., 2008; Gopal & Sivaramakrishnan, 2008; Gopal et al., 2003; Kalnins & Mayer, 2004; Susarla et al., 2009). Second, for that reason, there is a sufficient number of studies to support a meta-analysis. We identified 29 quantitative ITO studies that include an analysis of contract type. Third, the research question is a close fit to the basic assumptions of TCE. There is a specific governance decision, the choice of contract type, and the transaction costs are contingent on this choice. Therefore, a meta-analysis of the choice of contract type provides a lens on the competing explanations of the variance in findings when adopting a TCE framework to research the ITO industry.

The remainder of this paper is structured as follows. In section 2, we review the literature on how TCE explains the choice of contract type, and the effect of industry maturity on that choice. Section 3 describes the meta-analysis methodology, including the literature search, coding of studies, and analysis. Section 4 presents the results and section 5 discusses those results, their limitations, and implications for theory and practice. Section 6 presents the conclusions, highlighting the critical contribution from the research.

6.2 Theoretical background

TCE models the choice of contract type as a problem of minimizing transaction costs (Bajari & Tadelis, 2001; Corts & Singh, 2004; Kalnins & Mayer, 2004). Assuming asymmetric information between the client and vendor, the choice is a trade-off between monitoring and renegotiation costs (Osei-Bryson & Ngwenyama, 2006; Susarla et al., 2009). Monitoring costs are lower under FP contracts than under TM contracts. In contrast, renegotiation costs are higher under FP contracts than under TM contracts. TCE predicts that the preference for TM over FP contracts is a positive function of task environmental uncertainty (TEU).

As industries mature, TEU, client and vendor information asymmetry, and switching costs decline. Each of these changes reduces the observed strength of the relationship between choice of contract type and TEU in ITO. So, this relationship, which is predicted by TCE, becomes less important to the client as the ITO industry matures. Importantly, the validity of the general TCE theory is not affected. Rather, the theory is less relevant in the mature phase of the ITO industry.

6.2.1 Transaction cost economics and contract type

Monitoring costs are contingent on the resources that the client must expend to prevent the vendor from *shirking*. This refers to a vendor deliberately expending lower resources than specified in an ITO contract while claiming full payment under that contract. The risk of this behavior occurring decreases as client knowledge of project costs and project performance increases (Aron, Clemons, & Reddi, 2005).

Renegotiation costs are incurred when the context changes during the project and the contract specifications must be renegotiated. These costs are a positive function of the risk that a vendor uses its private information about the true costs of the required changes to *extract concessions* from the client (Bajari & Tadelis, 2001; Wathne & Heide, 2000).

The decision between FP and TM contracts mitigates the risk of opportunistic vendor behavior (Bajari & Tadelis, 2001; Kalnins & Mayer, 2004; Osei-Bryson & Ngwenyama, 2006; Susarla et al., 2009). Monitoring costs are lower under FP contracts than under TM contracts. In contrast, renegotiation costs are higher under the former than the latter. Therefore, choice of contract depends on the relative magnitudes of the transaction costs (Bajari & Tadelis, 2001; Susarla et al., 2009).

In FP contracts, cost overruns negatively affect the project profitability for the vendor (Ethiraj et al., 2005; Gopal & Koka, 2012; Gopal & Sivaramakrishnan, 2008; Gopal et al., 2003). Thus, FP contracts provide strong incentives for vendors to manage projects in a cost-efficient way (Bajari & Tadelis, 2001; Corts & Singh, 2004; Kalnins & Mayer, 2004). For example, vendors assign more trained personnel to FP compared with TM projects (Arora & Asundi, 1999; Gopal & Sivaramakrishnan, 2008).

In TM contracts, however, cost overruns are borne by the client. Thus, TM contracts do not provide strong incentives for vendors to control costs. Instead, coupled with information asymmetry, TM contracts motivate vendor opportunism in form of shirking (Osei-Bryson & Ngwenyama, 2006; Susarla et al., 2009). Under TM contracts, therefore, clients must monitor vendor behavior and performance closely to reduce information asymmetries and prevent vendors from shirking (Osei-Bryson & Ngwenyama, 2006; Susarla et al., 2009).

Renegotiation costs are higher under FP contracts compared with TM contracts (Bajari & Tadelis, 2001; Corts & Singh, 2004; Kalnins & Mayer, 2004). Typically, FP contracts include detailed project plans, including functional requirements, service levels, and costs (Fink et al., 2013). When unforeseen contingencies arise, project specifications must be renegotiated (Bajari & Tadelis, 2001). Therefore, coupled with information asymmetry, FP contracts provide both the opportunity and motivation for vendor opportunism in the form of extracting concessions from the client (Bajari & Tadelis, 2001; Wathne & Heide, 2000).

With vendors remunerated on the basis of reported working hours or days, TM contracts are more coarse-grained, allowing for adjustments during the course of the project (Fink et al., 2013). So, vendors under TM contracts, compared with vendors under FP contracts, are more willing to accept changes without the need for costly renegotiations (Kalnins & Mayer, 2004; Susarla et al., 2009).

Drawing on the above arguments, the ITO literature models the choice between FP contracts and TM contracts as a function of TEU, a core variable in the TCE framework (e.g., Bajari & Tadelis, 2001; Fink et al., 2013; Gopal et al., 2003; Kalnins & Mayer, 2004; Susarla et al., 2009). When the presence of unforeseen contingencies is expected to be high, the flexibility provided by TM contracts outweighs the incentives under FP contracts to control transaction costs (Bajari & Tadelis, 2001; Susarla et al., 2009). In addition, high TEU makes it difficult to draft a detailed FP contract ex-ante that could be used as the basis for evaluating the project ex-post (Crocker & Reynolds, 1993). Formally, within a TCE framework:

Hypothesis 1: In ITO, the frequency with which TM contracts are chosen instead of FP contracts is a positive function of TEU.

6.2.2 Industry maturity

There are two potential moderators to the research findings supporting Hypothesis 1. One is that the information asymmetry between client and vendor is not stable and declines as the ITO industry matures. The other is that TEU is not stable and also declines as the ITO industry matures.

The ITO industry has changed since the early 1990s from an emerging to a maturing industry (Bhatnagar & Madon, 1997; Manning et al., 2011; Stadtmann & Kreutter, 2009; Suarez et al., 2013). This development is partly a function of the increasing commoditization of the ITO industry. Commoditization has been achieved through service modularization, service standardization, and the decoupling of ITO services from particular projects and clients (Manning, 2013). Recent surveys conducted by the Offshoring Research Network report that 42% of the respondents considered ITO services to be highly commoditized in 2007, increasing to over 50% in 2009, and reaching 71% in 2011/12 (Manning, 2013).

Commoditization reduces TEU by reducing the variety in ITO service offerings and by fostering the emergence of standards and benchmarks. As a consequence, there is a reduction in the variance in the independent variable, TEU. This reduces the strength of the observed relationship between choice of contract type and TEU.

Commoditization also stimulates cost-based competition, which increases the pressure for further market consolidation within the ITO industry (Manning et al., 2011). Both commoditized services and market consolidation increase market transparency and lead to better informed clients (Reimann et al., 2010). Effectively, this reduces the information asymmetry between the client and the vendor, reducing the strength of the observed relationship between TEU and the choice of contract type.

For example, TCE predicts that there is a risk of shirking when clients have limited information about the task. The emergence of standards and benchmarks in commoditized industries increases client task knowledge and, thus, reduces the risk of shirking (Davenport, 2005; Manning et al., 2011). Similar arguments apply to the mitigation of vendor opportunism to extract concessions from clients.

The mitigating effect of increased market transparency on vendor opportunism in ITO projects is reinforced by the importance of vendor reputation in commoditized industries. Standardization and modularization of ITO services decrease switching costs for clients

(Reimann et al., 2010) and decrease vendor propensity to behave opportunistically. This would reduce the observed relationship between choice of contract type and TEU. Formally:

Hypothesis 2: The strength of the relationship between TEU and the frequency with which TM contracts are chosen instead of FP contracts is a negative function of ITO industry maturity.

6.3 Methodology

We investigated these hypotheses using meta-analysis, which is a suite of quantitative techniques to synthesize research findings across multiple studies (Glass, 1976; Hedges & Olkin, 1985; Hunter & Schmidt, 1990, 2004). The input data are effect sizes, specifically correlation coefficients from individual studies addressing the same relationship of interest (Lipsey & Wilson, 2001). Utilizing the total sample size by aggregating across the individual studies, meta-analyses enable researchers to estimate more reliable effect sizes than traditional review procedures such as narrative reviews or vote-counting approaches (Glass, McGaw, & Smith, 1981; Hunter & Schmidt, 1990, 2004; Rosenthal & DiMatteo, 2001).

Meta-analysis is a widely accepted methodology in related research domains including marketing, management, and psychology. Recently, it is increasingly being adopted in information systems (IS) research (see, e.g., He & King, 2008; Joseph et al., 2007; Sabherwal et al., 2006; Sharma & Yetton, 2003, 2007; Sharma et al., 2009; J. Wu & Lederer, 2009). Here, we describe the process of our meta-analysis under three headings: literature search, coding, and analysis.

6.3.1 Literature search

Our sample consists of empirical studies reported in journals, conference proceedings, dissertations, working papers, and forthcoming journal papers. We included conference papers, dissertations, and working papers to address the "file-drawer problem". This refers to the issue that published studies may systematically overestimate effect sizes compared to unpublished studies (Rosenthal, 1979).

Following the recommendations by Cooper (2010) and recent meta-analyses in IS (Sharma & Yetton, 2003, 2007; J. Wu & Lederer, 2009), we conducted four complementary literature searches. This minimized the probability of failing to identify relevant studies. First, we conducted a systematic keyword search in the following databases[10]: Business Source Premier, JSTOR, ScienceDirect, ABI/INFORM, ACM Digital Library, IEEE Xplore, The Association for Information Systems Electronic Library (AISeL), ProQuest Dissertations and Theses, and WorldCat Dissertations and Theses[11]. Second, we conducted backward and forward searches

[10] Following Sabherwal et al. (2006) we used one or more of several keywords related to IS outsourcing projects (i.e., "software", "information system", "information technology", "outsourcing") and one or more of several keywords related to contract type (i.e., "contract", "fixed price", "time and materials", "cost plus") and their variants (e.g., "fixed-price").

[11] These databases included the major journals and conference proceedings in the IS and management discipline such as Management Information Systems Quarterly (MISQ), Information Systems Research (ISR), Journal of Management Information Systems (JMIS), Management Science (MS), Academy of Management Journal (AMJ), Strategic Management Journal (SMJ), International Conference on Information Systems (ICIS),

(Webster & Watson, 2002). Third, we searched for working papers and forthcoming journal papers by screening the websites of key authors identified in the previous steps, conducting keyword searches in Google, and searching the Social Science Research Network (SSRN). Fourth, we sent requests for unpublished working papers using several mailing lists (e.g., AISworld and AOM OCIS).

A study is included in the meta-analysis if it satisfies three criteria. First, the study investigates ITO projects as its unit of analysis. Second, the study measures contract type and TEU. Third, the study reports the sample size and the correlation coefficients between contract type and TEU[12].

The resultant meta-analysis sample includes 29 studies based on 23 independent samples[13] providing 94 effect sizes representing a total sample size of 6,343 ITO projects[14,15].

6.3.2 Coding

For each study included in the meta-analysis, the following information was extracted: name and description of each variable that relates to TEU, the correlation coefficient between contract type and each variable, the measurement error for contract type and each variable in terms of reliability coefficients, the sample size, and the mean year of the data sample. Based on this information, we coded the dependent variable (contract type), the independent variable (TEU), and the moderating variable (ITO industry maturity) for each study.

Coding of the dependent variable

Many of the studies included in the meta-analysis operationalize contract type as a binary variable that distinguishes FP contracts and TM contracts. We converted the correlation coefficients, so that higher value of the contract type variables corresponds to a TM contract and lower value corresponds to a FP contract.

Coding of the independent variable

Frequently, TCE-based research operationalizes TEU with variables that relate to particular aspects of TEU, such as requirements uncertainty and technological uncertainty, or variables that are highly interrelated with TEU, such as technological complexity, organizational

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Americas Conference on Information Systems (AMCIS), European Conference on Information Systems (ECIS), and Hawaii International Conference on System Sciences (HICSS).

12 When these statistics were missing, we contacted the corresponding author of the study with a request to share the missing statistics with us. This lead to an inclusion of three additional studies providing 10 effect sizes.

13 Multiple studies based on the same sample were included only where each of these studies reports at least one operationalization of TEU that is not reported in the others. In this case, operationalizations of TEU that are reported in more than one of these studies were considered only once. Priority was given to the study based on the largest sample size.

14 Represented in the references section by asterisks.

15 Distributed across publication type as follows: journals (21), conference proceedings (4), dissertations (1), and working papers (3). Distributed across years as follows: 2000 (1), 2001 (0), 2002 (0), 2003 (0), 2004 (1), 2005 (1), 2006 (0), 2007 (2), 2008 (3), 2009 (4), 2010 (4), 2011 (4), and 2012 (9). Journals and conference proceedings providing the most studies: JMIS (4), MISQ (3), SMJ (3), and ICIS (3).

complexity, and project size (Bajari & Tadelis, 2001; Crocker & Reynolds, 1993; Fink et al., 2013; Kalnins & Mayer, 2004). Accordingly, we coded all those variables as TEU. This involved judgment by the coders (Heugens & Lander, 2009). To minimize coding errors, we adopted the protocol recommended by Lipsey and Wilson (2001). The coding protocol is available from the corresponding author on request. It is not reported here because of the page restriction on this paper. Two coders independently coded each study. Cohen's (1960) kappa is 0.94, demonstrating high inter-coder reliability. Disagreements between the coders were resolved through discussion.

When a study contained more than one variable related to TEU (e.g., a study includes a variable related to project size and a variable related to requirements uncertainty), we averaged the corresponding effect sizes (Hunter & Schmidt, 2004; Palmatier et al., 2006). This avoids biased estimates that would result from including dependent effect sizes in a meta-analysis (e.g., He & King, 2008; Palmatier et al., 2006). In total, 94 initial effect sizes were combined to 23 independent effect sizes.

Coding of the moderating variable

The moderating variable, ITO industry maturity, was coded as a binary variable. This is consistent with the practice in the strategic management literature on industry maturity, which distinguishes between an early (emerging) and a later (mature) phase of an industry (see, e.g., Agarwal, Sarkar, & Echambadi, 2002; Suarez et al., 2013). These two phases are separated by a point in time – the onset of maturity (Suarez et al., 2013). In a study of software-as-a-service outsourcing, Susarla and Barua (2011) identified the year 2001 as the onset of maturity in the ITO industry. Accordingly, we adopted the same year to partition the emerging from the mature phase of the ITO industry.

For each study included in the meta-analysis, we calculated the mean year of the data sample (i.e., the mean of the years in which the ITO projects were conducted). If the mean year of the data sample was later than 2001, industry maturity was coded as "high" (mature phase). Otherwise, industry maturity was coded as "low" (emerging phase).

6.3.3 Analysis

The analysis is presented in three stages. First, to test Hypothesis 1, the main effect of TEU on contract type is estimated. Second, to test Hypothesis 2, the moderating effect of industry maturity on the relationship between TEU and contract type is analyzed. Third, a robustness check is conducted to control our results for varying operationalizations of TEU.

Main effect

The unit of analysis is a zero-order, Pearson product-moment-correlation coefficient. It is a well understood, scale-free measure of the relationship between two variables (Rosenthal & DiMatteo, 2001). The Fisher z transformation was not adopted. It introduces an expected positive bias, which is larger than the expected negative bias when using untransformed correlation coefficients (Hall & Brannik, 2002; Hunter & Schmidt, 2004).

The correlation coefficients were corrected for measurement error (Hunter & Schmidt, 2004). Specifically, each correlation coefficient was divided by the product of the square root of the

reliability coefficients for contract type and the TEU variable. If a measurement was based on a single-item or a proxy variable, we adopted a conservative standard of 0.8 for the reliability coefficient (Bommer et al., 1995; Dalton et al., 2003; Dalton et al., 1998; Dalton et al., 1999; K. Jiang et al., 2012; Sleesman et al., 2010).

Following recent meta-analyses in IS (e.g., Joseph et al., 2007; Sabherwal et al., 2006), the Hunter and Schmidt (2004) random effects model was adopted. Weighting the corrected correlation coefficients by sample size and reliability, the following meta-analytic outcomes were estimated: the number of effect sizes (k), the total sample size (N), the average corrected correlation (expected rho; $\bar{\rho}$), the standard deviation of rho (SD_ρ), and the 95 percent confidence interval around the expected rho ($CI_{\bar{\rho};.95}$)[16]. Positive values of the expected rho indicate that the frequency with which TM contracts are chosen instead of FP contracts is a positive function of TEU. Negative values of the expected rho indicate that the frequency with which TM contracts are chosen instead of FP contracts is a negative function of TEU. The relationship is statistically significant when the 95 percent confidence interval around the expected rho does not include zero.

In addition, we calculated three meta-analytic outcomes to assess the generalizability of the results: the 80 percent credibility interval around the expected rho ($CR_{\bar{\rho};.80}$), the percentage of variance that is accounted for by statistical artifacts ($\%V$), and Cochran's (1954) chi-square statistic for heterogeneity (Q). We assessed generalizability as follows: In contrast to the confidence interval, which refers to the accuracy of a single estimate, the expected rho, the credibility interval refers to the distribution of the rho and is used to assess the generalizability of the expected rho (Hunter & Schmidt, 2004). When the credibility interval is large or includes zero, the expected rho does not generalize (Whitener, 1990). Instead, the distribution of rho is assumed to be heterogeneous. Similarly, if less than 75 percent of the observed variance in the rho can be accounted for by statistical artifacts, Hunter and Schmidt (2004) suggest a relationship to be heterogeneous. When Cochran's (1954) chi-square statistic is significant, the expected rho does not generalize. Instead, it should be interpreted as the expected value of a number of effects rather than a common true effect (Hedges & Olkin, 1985).

Moderating effect

We use an ANOVA-based subgroup-analysis procedure (Borenstein et al., 2009) to analyze the moderating effect of industry maturity on the relationships between contract type and TEU. The studies included in the meta-analyses are partitioned into two ITO industry maturity subgroups: "low" (emerging phase) and "high" (mature phase).[17] The meta-analytic outcomes described above are replicated for each subgroup.

The procedure described by Borenstein et al. (2009) is based on a decomposition of Cochran's (1954) chi-square statistic for heterogeneity (see, e.g., T.-Y. Park & Shaw, 2013). In the analysis reported here, a relationship with a significant $Q_{between}$-statistic is interpreted as showing that

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[16] We used Hunter and Schmidt's (2004) formula for individually corrected correlation coefficients to calculate the standard errror of the estimated average correlations: $SE_{\bar{\rho}} = SD_r/\sqrt{k}$.

[17] We excluded one study from the subsample analysis because we were not able to obtain the mean year of the data sample for the study.

the effect size is contingent on industry maturity. Specifically, industry maturity moderates the effect of TEU on the choice of contract type.

Robustness check

Previous research suggests that varying operationalizations of TCE's core variables might cause mixed TCE results in ITO research (David & Han, 2004; Karimi-Alaghehband et al., 2011). Specifically, research highlighted the mixed results with varying operationalizations of uncertainty (Carter & Hodgsen, 2006). To control for variations between different operationalizations of TEU, we additionally conducted the meta-analytic calculations for each operationalization of TEU separately. In this analysis, the 94 initial effect sizes were combined into 64 independent effect sizes.

6.4 Results

The results in Table 19 support Hypothesis 1: *In ITO, the frequency with which TM contracts are chosen instead of FP contracts is a positive function of TEU.* The 95 percent confidence interval does not include zero, supporting Hypothesis 1. However, the effect size ($\bar{\rho} = .10$) is small by conventional standards (Cohen, 1988). Across all three criteria to assess the generalizability of the relationships ($CR_{\bar{\rho};.80}$, $\%V$, Q), Table 19 reports a significant degree of heterogeneity, indicating that the relationship is moderated by other variables.

Relationship	k	N	$\bar{\rho}$	SD_ρ	$CI_{\bar{\rho};.95}$	$CR_{\bar{\rho};.80}$	$\%V$	Q
TEU → Contract type is TM	23	6,343	.10	.09	.05 : .14	–.02 : .21	0.40	56.32*

Notes. k: number of effect sizes; N: total sample size; $\bar{\rho}$: expected rho; SD_ρ: standard deviation of rho; $CI_{\bar{\rho};.95}$: 95% confidence interval around the expected rho; $CR_{\bar{\rho};.80}$: 80% credibility interval around the expected rho; Q: Cochran's chi-square statistic for heterogeneity; *: p-value of $Q < 0.05$.

Table 19. TEU and contract type

Table 20 presents the meta-analytic results for the relationships between TEU and contract type, controlling for industry maturity. The results support Hypothesis 2: *The strength of the relationship between TEU and the frequency with which TM contracts are chosen instead of FP contracts is a negative function of ITO industry maturity*. The $Q_{between}$-statistic is significant ($Q_{between}$ = 8.35*), supporting Hypothesis 2. In the emerging phase, the effect of TEU on TM contracts is larger ($\bar{\rho} = .14$) than in the mature phase ($\bar{\rho} = .05$). Furthermore, the effect of TEU on contract type is significant only in the emerging phase. In the mature phase, it is not significant (see the 95 percent confidence intervals).

Table 21 presents the meta-analytic results for the relationships between TEU and choice of contract type, controlling for both industry maturity and different operationalizations of TEU. In the emerging industry phase, estimating the relationship between TEU and choice of contract type, requirements uncertainty has the largest significant effect ($\bar{\rho} = .23$), organizational complexity the lowest significant effect ($\bar{\rho} = .12$), and technological complexity the lowest non-significant effect ($\bar{\rho} = .05$). So, contingent on the operationalization of TEU, the effect of TEU on choice of contract type ranges from 0.05 to 0.23 in Table 3 with an expected value of

0.14. In contrast, in the mature phase, the effect of TEU on choice of contract type is not significant, regardless of how TEU is operationalized.

Relationship	k	N	$\bar{\rho}$	SD_ρ	$CI_{\bar{\rho};.95}$	$CR_{\bar{\rho};.80}$	%V	Q_{within}
TEU → Contract type is TM ($Q_{between}$ = 8.35*)								
Emerging phase	12	3,249	.14	.08	.08 : .20	.04 : .24	0.50	23.67*
Mature phase	10	2,999	.05	.09	–.02 : .12	–.06 : .16	0.41	24.17*

Notes. k: number of effect sizes; N: total sample size; $\bar{\rho}$: expected rho; SD_ρ: standard deviation of rho; $CI_{\bar{\rho};.95}$: 95% confidence interval around the expected rho; $CR_{\bar{\rho};.80}$: 80% credibility interval around the expected rho; Q_{within}: Cochran's chi-square statistic for heterogeneity that is explained by the moderator variable; Q_{within}: Cochran's chi-square statistic for heterogeneity that remains within the subsample; *: p-value of $Q < 0.05$.

Table 20. TEU and contract type: Controlling for industry maturity

Relationship	k	N	$\bar{\rho}$	SD_ρ	$CI_{\bar{\rho};.95}$
TEU → Contract type is TM					
Emerging phase					
Technological uncertainty	2	559	.17	.15	–.06 : .40
Requirements uncertainty	4	793	.23	.15	.06 : .39
Technological complexity	10	2,986	.05	.06	–.01 : .11
Organizational complexity	6	1,826	.12	.08	.03 : .21
Project size	12	3,243	.20	.10	.13 : .27
Mature phase					
Technological uncertainty	3	753	.05	.04	–.05 : .15
Requirements uncertainty	6	1,508	.08	.13	–.04 : .20
Technological complexity	5	1,434	.02	.11	–.09 : .13
Organizational complexity	8	2,803	–.06	.17	–.18 : .07
Project size	8	2,462	.10	.21	–.06 : .25

Notes. k: number of effect sizes; N: total sample size; $\bar{\rho}$: expected rho; SD_ρ: standard deviation of rho; $CI_{\bar{\rho};.95}$: 95% confidence interval around the expected rho.

Table 21. Effect sizes for different measures of TEU

6.5 Discussion

The results in Table 19 show that TEU has a significant but small effect ($\bar{\rho} = .10$) on choice of contract type (Hypothesis 1). In addition, the results indicate heterogeneity in this relationship, which is indirect evidence for Hypothesis 2.

Controlling for the effect of industry maturity, the results in Table 20 show that the effect of TEU on contract type is contingent on ITO industry maturity (Hypothesis 2). The relationship between choice of contract type and TEU is stronger in the emerging phase than in the mature phase of the ITO industry. Specifically, the relationship is significantly positive in the emerging phase of the ITO industry and is non-significant in the mature phase.

Controlling for the effects of both industry maturity and different operationalizations of TEU, the results in Table 21 show that, in the emerging industry phase, the relationship between TEU and choice of contract type is significant for three measures of TEU, namely, requirements uncertainty, organizational complexity, and project size (see the 95% confidence intervals in Table 21). In the mature phase, the relationship between TEU and choice of contract type is non-significant for all the measures of TEU (See Table 21).

6.5.1 Limitations

Meta-analysis is subject to a number of limitations. Five of the most frequently identified validity threats to meta-analysis findings are reviewed here. First, we were not able to identify and include all empirical research studies on contract type choice in ITO research. Although we conducted an extensive literature search, the possibility remains that we did not identify all the studies. Furthermore, some studies did not report the necessary statistics and, thus, are not included in the meta-analysis. However, considering the extensive nature of the search process, we are confident that any excluded studies would not substantially affect the results presented above.

Second, estimates of the expected rhos, for example, in the robustness check, are based on a small number of effect sizes. Whereas a small number of effect sizes does not bias the estimates of the expected rhos, it does affect the estimate of the standard deviation of the rhos that are used to calculate the credibility intervals (Hunter & Schmidt, 2004). We, therefore, additionally estimated Hunter and Schmidt's (2004) 75 percent rule and Cochran's (1954) chi-square test for heterogeneity. There is no evidence of bias in the findings presented in Table 19, Table 20, and Table 21.

Third, although the coding of TEU resulted in high inter-coder reliability, the process of designing the coding scheme itself involved some subjectivity. We were careful in designing the coding scheme: The variables were assigned to the operationalizations of TEU based on their explicit use in primary studies. However, when this was in doubt, the assignment was discussed and resolved between two of the authors.

Fourth, we corrected our results only for the three statistical artifacts that are present in every individual study: sampling error, measurement error of TEU, and measurement error of contract type. Hunter and Schmidt (2004) describe procedures to correct for other statistical artifacts including range restriction and dichotomization of continuous variables. However, information that must be extracted from the individual studies to correct for these artifacts is rarely available and is, thus, beyond the scope of this meta-analysis.

The fifth threat is the file-drawer problem (Rosenthal, 1979). This refers to the potential bias that the results of unpublished studies differ systematically from the results of published studies. We searched extensively for conference papers, dissertations, and working papers to address

this issue. Twenty eight percent of the studies included in the meta-analysis fall into these three categories. We are confident that the file-drawer problem is not a potential major validity threat to the results.

6.5.2 Implications for theory and practice

Two recent empirical reviews report mixed support for the TCE logic in ITO research. Approximately 50% of the TCE-based hypotheses are not supported or are even contradicted in extant ITO research (Karimi-Alaghehband et al., 2011; Lacity et al., 2011). Our results support these findings. While the meta-analytic results in Table 19 report a small significant effect of TEU on choice of contract type, Table 19 also reports significant heterogeneity in that relationship. With a small main effect, the probability of a Type II error is high, accounting for the high frequency of non-significant findings.

Partitioning the correlations used to compute the results in Table 19 between those that significantly support and do not significantly support the logic of TCE, 41% supported the logic of TCE and 59% did not support the logic of TCE (Table 22). These findings are similar to or slightly higher than those reported by Lacity et al. (2011) and Karimi-Alaghehband et al. (2011). So, the results reported here are unlikely to be specific to the research domain defined by the choice of contract type and are expected to generalize to other TCE-based hypotheses concerning ITO. Future research should confirm this.

TEU → Contract type is TM	***k***	**TCE logic supported**	**TCE logic NOT supported**
Emerging phase	12	6 (50%)	6 (50%)
Mature phase	10	3 (30%)	7 (70%)
Total	22	9 (41%)	13 (59%)

Notes. *k*: number of effect sizes.

Table 22. The relationship between TEU and contract type, and industry maturity

Lacity et al. (2011) and Karimi-Alaghehband et al. (2011) present different explanations for these mixed results. Karimi-Alaghehband et al. (2011) argue that insufficient rigor, such as varying construct operationalizations, may have caused the mixed TCE-support in empirical ITO research. The results of our robustness check indicate that methodological rigor does indeed play an important role in explaining the mixed results in the emerging phase of the ITO industry. Our results show differences in effect size and significance levels for different operationalizations of TEU (See Table 21). However, in the mature ITO industry phase, Table 21 reports that the relationship between TEU and contract type is not significant for all five measures of TEU.

In contrast, Lacity et al. (2011) argue that TCE may not be applicable to the ITO context because the assumptions underpinning TCE may not hold for client-vendor relationships in the ITO industry. The results presented in Table 20 show that, while the assumptions of vendor opportunism and information asymmetries between client and vendor may have held in the emerging phase of the ITO industry, they do not hold for the mature phase.

Inspecting Table 20, industry maturity explains a significant share of the variance in the relationship between TEU and contract type. Furthermore, the effect of TEU on contract type in the mature ITO industry phase is not significant. Client learning, reducing the asymmetric knowledge between clients and vendors, and industry commoditization, reducing TEU, combine to make the TCE analytical framework of limited importance to explain the choice of contract type in the mature phase of the ITO industry.

Based on their competing explanations, Lacity et al. (2011) and Karimi-Alaghehband et al. (2011) draw different conclusions about what do next. Lacity et al. (2011) conclude that ITO research should move beyond TCE and call for the development of an "endogenous" ITO theory. Karimi-Alaghehband et al. (2011) conclude that TCE should be applied more faithfully in future ITO research. Our results provide some support for both explanations.

However, the implications of our findings for the effects of ITO industry maturity support Lacity et al.'s (2011) general conclusion for future research, as the ITO market is now maturing or is already mature. In addition, our findings are consistent with research conducted elsewhere on industry maturity (e.g., Agarwal et al., 2002; Argyres & Bigelow, 2007; Karniouchina, Carson, Short, & Ketchen, 2013; Misangyi, Elms, Greckhamer, & Lepine, 2006; Suarez et al., 2013). In particular, studying the automotive industry, Argyres and Bigelow (2007) show that the effect of transaction misalignment on firm survival varies between maturity phases of the automotive industry. They conclude that the explanatory power of TCE depends on the maturity of an industry. Our results supporting Hypothesis 2 generalize their conclusions to the ITO industry.

It is interesting to speculate why the variance in findings reported by Lacity et al. (2011) and Karimi-Alaghehband et al. (2011) have not been researched earlier. An inspection of the studies included in this meta-analysis suggests an explanation that should be further researched. We identified 29 studies that measure the correlation between contract type and TEU. However, only eight of these studies formally test this relationship. In the others, for example, contract type is used as a control or moderator when testing other relationships.

Of the eight studies that test the relationship investigated here, seven were researched in the emerging phase and one in the mature phase. Of the former, six report supporting results and one reports not supporting results. The single study in the mature phase reports mixed results. It is possible that researchers internalized the effects of TCE-based hypotheses studied in the emerging phase. Then, developing extensions to that basic model during the more recent mature phase, researchers did not recognize the potential importance of null findings for the effects of their control variables.

Finally, accepting the challenge proposed by Lacity et al. (2011), the critical question is: What would an "endogenous" ITO theory look like? It is hard to believe that ITO vendors, for example, IBM, would adopt shirking, for example, as part of their strategy. The reputation effects would be serious and potentially fatal (Dibbern et al., 2008).

Instead, drawing on Hoberg, Yetton, Leimeister, and Krcmar (2013), we propose that the new analytical framework should focus on client behavior as the critical aspect. Variance in client behavior to manage the client-vendor relationship is likely to be much larger than differences in vendor behavior. Vendors have many more opportunities to learn by doing than do clients. This would fundamentally reframe the theory of ITO to be client behavior-centric and not based

on a model of a market in which major service organizations are assumed to defect on their contracts with their clients.

6.6 Conclusion

This study was motivated by the high variance in results reported in ITO research when TCE is adopted as the analytical framework. Informed by insights from the strategic management literature (Argyres & Bigelow, 2007) and recent market developments in the ITO industry, including increasing commoditization, consolidation, and market transparency, we develop an explanation for these mixed results as a function of ITO industry maturity.

The hypothesis is that the choice between FP contracts and TM contracts is contingent on industry maturity. The meta-analytic results show that contract type choice hypotheses derived from TCE are supported in the emerging phase of the ITO industry but not in the subsequent mature phase. Note that this study is not a test of the validity of the TCE theory. Rather, it is a test of whether the theory is relevant to explain the choice of contract type in the mature phase of the ITO industry.

The contribution of this paper takes two forms. One contribution is to ITO research in which TCE is the dominant analytical framework. Two recent reviews provide competing explanations for the variance in research results with different implications for both practice and future research (Karimi-Alaghehband et al., 2011; Lacity et al., 2011). Our results allow us to partially reconcile the competing explanations, and to conclude that a TCE-based analytical framework is not relevant to ITO research post 2001. We propose that an "endogenous" ITO theory should focus on differences in client behavior rather than on vendor behavior. This would change the analytical framework from a vendor-centric to a client-centric model, and focus the practitioner on how the client leverages the vendor's capabilities rather than protecting itself from potential vendor threats.

The other contribution is to the industry maturity literature. Our results support the significance of industry maturity phases in that general debate. Past research focused on several relationships that may vary across phases in industry maturity, including antecedents of firm performance (Karniouchina et al., 2013) and consequences of transaction misalignment for firm survival (Argyres & Bigelow, 2007). This study extends the general maturity-based literature to research on governance decisions in buyer-supplier relationships in the global ITO industry.

6.7 Appendix

No.	Reference	ITO industry maturity phase
1	Argyres et al. (2007)	emerging
2	Banerjee and Duflo (2000)	emerging
3	Bapna et al. (2012)	emerging
4	Y. Chen and Bharadwaj (2009a)	emerging

5	Y. Chen and Bharadwaj (2009h)	emerging
6	Y. Chen and Heng (2012)	emerging
7	Ethiraj et al. (2005)	emerging
8	Gefen et al. (2008)	mature
9	Gopal and Koka (2012)	emerging
10	Hoermann et al. (2012)	mature
11	Huckman and Staats (2011)	mature
12	Kalnins and Mayer (2004)	emerging
13	Langer (2007)	mature
14	Mani et al. (2013)	emerging
15	Maruping and Ahuja (2012)	mature
16	Pee et al. (2010)	- (no information provided)
17	Rai et al. (2009)	mature
18	Ramachandran and Gopal (2010)	emerging
19	Ramasubbu, Bharadwaj, and Tayi (2013)	mature
20	Srivastava and Teo (2012)	mature
21	Staats et al. (2011)	mature
22	Staats et al. (2012)	mature
23	Subramanyam and Susarla (2011)	emerging
24	Susarla (2012)	emerging
25	Susarla et al. (2009)	emerging
26	Tiwana (2008a)	mature
27	Tiwana (2008d)	mature
28	Tiwana (2010)	mature
29	Weber et al. (2011)	emerging

Table 23. Studies included in the analysis of S2

7 Hierarchical and market-based control relationships[18]

Title	Control and performance in IS projects: A meta-analysis of hierarchical and market-based control relationships
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Outlet	35th International Conference on Information Systems 2014
Abstract	Literature on IS project control distinguishes between hierarchical and market-based control relationships. Prior studies typically investigate one of these two forms of control relationships in isolation. Hence, little is known about the differences between hierarchical and market-based control relationships. Responding to this gap, we analyze how the effects of control modes on IS project performance differ in hierarchical compared with market-based control relationships. Specifically, we conduct a meta-analysis to compare the effects of control modes on IS project performance reported in research on hierarchical and market-based control relationships. The results suggest that the effects of behavior and self-control on performance differ between these two forms of control relationships. Based on our results, we derive implications for complementary and substitutive effects between control modes, and for interrelations among hierarchical and market-based control relationships.
Keywords	IS control, IS outsourcing, IS project management, IS project success, meta-analysis, governance
Individual contribution	Ideation, hypotheses development, design of data analysis, interpretation of results, and manuscript writing

Table 24. Bibliographic details for S3

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7.1 Introduction

There is an extensive literature on the relationship between control and information systems (IS) project performance. In this literature, control is defined as a process by which the controller provides guidance to the controllee (Goo et al., 2009) and aligns the controllee's with the controller's goals (Kirsch et al., 2002). The general finding is one of a positive effect of control on project performance (e.g., C. C. Chen, Liu, & Chen, 2011; Henderson & Lee, 1992; S. Liu, Keil, Rai, Zhang, & Chen, 2008).

This literature on IS project control can be partitioned into two research streams (Gopal & Gosain, 2010; Kirsch et al., 2002). In one, hierarchical control relationships are the unit of analysis: A project manager controls the project team members within an organization (e.g., Henderson & Lee, 1992). In the other stream, market-based control relationships are the unit of analysis: A client representative controls a vendor project manager when implementing an outsourcing strategy (e.g., Tiwana, 2010).

Prior studies typically investigate these two forms of control relationships independently. Hence, hierarchical and market-based control relationships "are not explicitly separated in theoretical treatment" (Gopal & Gosain, 2010, p. 961). The absence of a comparative analysis of these two research streams raises questions for both theory and practice.

In theory, the question is: *What are the similarities and differences between hierarchical and market-based control relationships* (Gopal & Gosain, 2010). For practice, the question is: *How should project managers and client representatives choose appropriate controls in hierarchical compared with market-based relationships* (Choudhury & Sabherwal, 2003; Kirsch, 2004). We address these two questions by theoretically integrating the two research streams and estimating the effects of control on IS project performance for hierarchical and market-based control relationships.

We adopt meta-analysis to compare and contrast the effect of control on IS project performance in hierarchical and market-based control relationships. Our results provide strong support for the general claim that the effect of control on IS project performance differs between hierarchical compared with market-based control relationships. Building on our results, we derive implications on the structure of control portfolios in hierarchical and market-based control relationships. In addition, we explore interrelations among hierarchical and market-based control relationships to guide future IS project control research.

The remainder of this paper is structured as follows. In the next section, we review the literature on control in IS projects and derive four hypotheses for the effects of control on IS project performance. The third section describes the meta-analysis methodology, including the literature search, coding of studies, analysis, and limitations. The fourth section presents the results. The fifth section discusses the findings and implications for theory and practice. The last section presents our conclusions, highlighting the contributions.

7.2 Theoretical background and hypotheses

We begin by briefly reviewing the literature on control in IS projects. As background, this documents the literature on which we draw to develop four hypotheses covering the various

effects of control on IS project performance in hierarchical and market-based control relationships. Taking this as our point of departure, we identify the critical differences between hierarchical and market-based control relationships. These are then used to develop hypotheses that specify how the effect of control on IS project performance differs between hierarchical compared with market-based control relationships.

7.2.1 Control in IS projects

Control refers to "any process in which a person or group of persons or organization of persons [the controller] determines […] what another person or group or organization [the controllee] will do" (Tannenbaum, 1962, p. 239). This process incorporates formal (i.e., behavior and outcome control) and informal (i.e., clan and self-control) control modes. Behavior control provides guidance from the controller to the controllee on appropriate behavior and the processes to be followed (Goo et al., 2009). Outcome control aligns the controllee's with the controller's goals (Kirsch et al., 2002). Informal control modes are used especially in cases where the controller is not able to exert formal control modes (Kirsch, 1997), supplementing the formal control modes (Tiwana & Keil, 2010).

Effective[19] use of each of the four control modes requires three essential activities: control specification, control evaluation, and control feedback, including rewards and sanctions (Ouchi, 1977). The specific design of these activities is contingent on which of the four control modes is selected (Jaworski, 1988; Kirsch, 1997; Ouchi, 1979).

First, behavior control requires the controller to specify procedures to be followed by the controllee (Ouchi, 1977). These procedures include both technical and organizational procedures. The former include, for example, the development methodology (Choudhury & Sabherwal, 2003) and programming methodologies (Nidumolu & Subramani, 2003). The latter include, for example, work assignment, role definitions, and responsibilities (Henderson & Lee, 1992). The controller evaluates whether the controllee follows the specified procedures, and rewards or sanctions accordingly (Kirsch, 2004). Control theory proposes that effective behavior control is contingent on two conditions being satisfied. One is that the controller must be able to specify the appropriate behavior for the controllee (Ouchi, 1979). The other is that the controller must be able to monitor that behavior (Kirsch, 1996; Ouchi, 1979).

Second, outcome control requires the controller to specify products and/or services to be delivered by the controllee (Ouchi, 1977). Product-related or quality-based outcome control (Gopal & Gosain, 2010) refers to the functional and nonfunctional requirements, which determine the expected level of performance (Henderson & Lee, 1992). Process-related or efficiency-based outcome control (Gopal & Gosain, 2010) refers to defined budgets and schedules (Kirsch, 1996). At specified stages, the controller evaluates whether the controllee has achieved the specified outcomes, and rewards or sanctions accordingly (Kirsch, 2004). Effective outcome control is contingent on the controller being able to measure the outcomes (Ouchi, 1979).

Third, clan control requires the controller and the controllee to build a joint clan based on socialization around shared goals (Kirsch, 1997; Ouchi, 1980). These goals include shared norms, values, beliefs, trust, and mental models specifying appropriate behavior on the project

[19] Throughout this paper, the term *effective* is used to describe positive effects on IS project performance.

(Srivastava & Teo, 2012; Tiwana, 2008d). In discussions, dialogs, and meetings, the clan evaluates, often implicitly, whether a member's actions are consistent with the clan's promulgated values and beliefs (Kirsch, 2004; Ouchi, 1980). Based on this judgment, the clan rewards and sanctions the member. Rewards include group recognition. Sanctions include peer pressure (Kirsch, 1997). Effective clan control is contingent on the project members, the clan, establishing strong group norms.

Fourth, self-control requires the controllee to specify both the goals and the actions required to achieve the goals (Henderson & Lee, 1992; Kirsch, 1996). Thus, self-control cannot be enforced by the controller but relies on the controllee (Kirsch, 2004). During or after the project, the controllee evaluates whether they are following, or have followed, the specified actions and whether they are achieving, or have achieved, the specified goals (Kirsch & Cummings, 1996). Based on this self-monitoring, the controllee rewards and/or sanctions themselves (Kirsch & Cummings, 1996). Effective self-control is contingent on two conditions being satisfied. One is that the controllee must have the autonomy to control their own actions (Kirsch et al., 2002). The other is that the controllee must possess the relevant expertise to specify the required actions and establish self-set goals (Henderson & Lee, 1992).

7.2.2 Hierarchical and market-based control relationships

The distinction between hierarchical and market-based control relationships is well established in the IS literature (e.g., Choudhury & Sabherwal, 2003; Gopal & Gosain, 2010; Kirsch et al., 2002). Hierarchical control relationships involve vertical/internal relationships between controllers and controllees. Typically, a project manager (superior) controls project team members (subordinates) within an organization (Henderson & Lee, 1992; Ouchi, 1977; Williamson, 1979). Market-based control relationships involve horizontal/external relationships between controllers and controllees. Typically, a client representative controls a vendor project manager. Figure 10 depicts these differences. In practice, hierarchical and market-based control relationships are not mutually exclusive and may exist simultaneously (Gopal & Gosain, 2010).

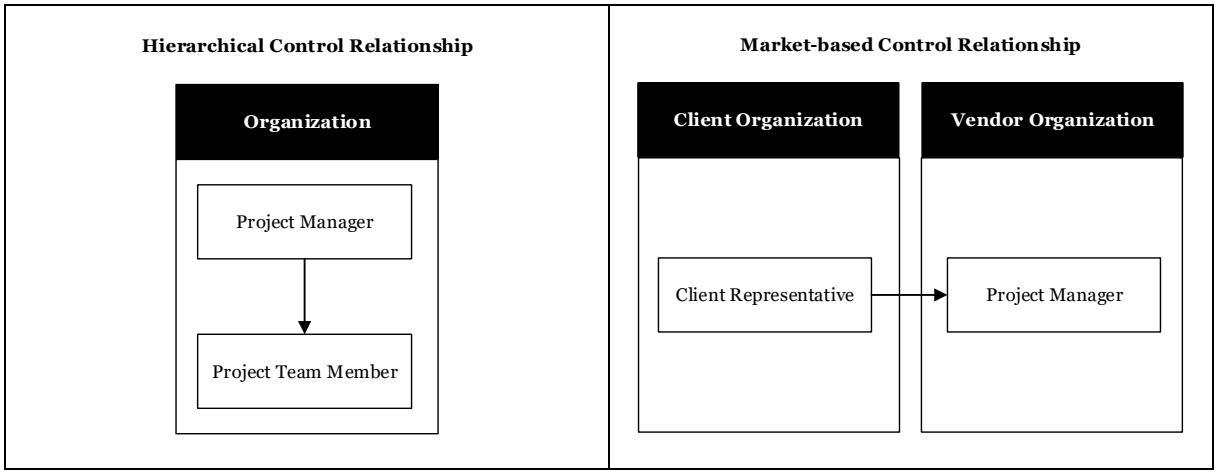

Figure 10. Hierarchical and market-based control relationships

To investigate hierarchical control relationships, prior research has adopted Ouchi's (1977, 1979, 1980) seminal work on hierarchical control (e.g., Guinan & Faraj, 1998; Henderson & Lee, 1992; G. Klein, Beranek, Martz, & Jiang, 2006). Kirsch et al. (2002) argue that the prior

theoretical thinking in IS project control had been limited to organizational hierarchies, in which a superior controls a subordinate, and call for future research on the use and impact of control in market-based control relationships.

Responding to that call, research has investigated market-based control relationships in IS projects (e.g., Keil et al., 2013; Nagpal, Lyytinen, & Boland Jr., 2012; Srivastava & Teo, 2012). However, within this literature, hierarchical and market-based control relationships "are not explicitly separated in theoretical treatment" (Gopal & Gosain, 2010, p. 961). For example, Choudhury and Sabherwal (2003) analyze control in outsourced IS projects but do not explicitly distinguish between hierarchical and market-based control relationships.

In this paper, we explicitly model the similarities and the differences between hierarchical and market-based control relationships in IS projects. Five differences are identified and examined. Table 25 summarizes these differences. First, an organizational boundary between the controller and the controllee exists in market-based control relationships, where the controller and the controllee are members of different organizations. In hierarchical control relationships, the controller and the controllee are both members of the same organization. Organizational boundaries restrict the effective transfer of information between organizations (Tushman, 1977). Thus, organizations engage in boundary spanning to realize effective information transfer (March & Simon, 1958). For example, Gopal and Gosain (2010) report a moderating effect of boundary spanning activities on the relationship between control and IS project performance.

Second, the controller's legitimate authority over the controllee is higher in hierarchical control relationships, where the project manager is the superior of the project team members (Henderson & Lee, 1992). In contrast, legitimate authority is lower in market-based control relationships (Ouchi, 1979). Prior literature argues that the relationship between control and IS project performance is contingent on the controller's legitimate authority (Tiwana, 2008d; Tiwana & Keil, 2007).

Third, the controller's knowledge of the transformation process is higher under conditions of hierarchical control, in which the project manager is the controller, compared with market-based control relationships, in which the client representative is the controller. In hierarchical control relationships, the project manager holds high technical expertise, developed by conducting a large number and variety of IS projects (Levina & Ross, 2003). In market-based control relationships, the client representative has limited technical knowledge because they frequently lack an in-depth understanding of IS development (Keil et al., 2013). Knowledge of the transformation process is a critical antecedent of control (Ouchi, 1979) and is posited to influence the effectiveness of control (Choudhury & Sabherwal, 2003; Kirsch et al., 2002).

Fourth, controllee behavior observability refers to the controller's ability to monitor the controllee's behavior (Kirsch, 1996). This is critical to the application of agency theory to control theory (Eisenhardt, 1985; Jensen & Meckling, 1976). Controllee behavior observability is higher in hierarchical compared with market-based control relationships. In hierarchical control relationships, the project manager can frequently directly observe the behavior of the project team members (Henderson & Lee, 1992). In contrast, in market-based control relationships, it is difficult for the client representative to observe the behavior of the project manager and project team members (Choudhury & Sabherwal, 2003). Dibbern et al. (2008) extend this finding to the offshoring context. They argue that the distance between the client

and the vendor makes monitoring project team behavior by the client representative difficult and costly.

Fifth, shared values and beliefs are frequently higher in hierarchical compared with market-based control relationships. In hierarchical control relationships, shared values and beliefs are developed through the close and permanent working relationship between the project manager and the project team members (Henderson & Lee, 1992). In addition, since the controller and the controllee belong to the same organization, they are more likely to share the same values and beliefs (Tiwana & Keil, 2010). In market-based control relationships, shared values and beliefs are lower because prior interactions are frequently limited or non-existent (Choudhury & Sabherwal, 2003).

Characteristics	**Hierarchy**	**Market**
Organizational boundary between controller and controllee (March & Simon, 1958)	No boundary	High boundary
Controller's legitimate authority over the controllee (Ouchi, 1979)	High	Low
Controller's knowledge of the transformation process (Ouchi, 1979)	High	Low
Observability of controllee behavior (Eisenhardt, 1985)	High	Low
Shared values and beliefs (Ouchi, 1979)	High	Low

Table 25. Differences between hierarchical and market-based control relationships

7.2.3 The effects of control modes on IS project performance

Based on the distinctions in Table 25, we hypothesize how the effects of control modes on IS project performance differ between hierarchical compared with market-based control relationships. IS project performance is broadly categorized in terms of efficiency and effectiveness (Hoegl & Gemuenden, 2001; Wallace et al., 2004a). The efficiency dimension refers to the extent to which the project is well managed – that is, process performance (Hoegl & Gemuenden, 2001). The effectiveness dimension refers to the extent to which the project outcomes meet quality expectations – that is, product performance (Henderson & Lee, 1992). Gopal and Gosain (2010) argue that the efficiency and effectiveness dimension are interrelated. Accepting their argument, we study the effects of control modes on the combined performance dimensions.

Behavior control involves the controller specifying procedures that must be followed by the controllee (Ouchi, 1979). Since the controller's main interest is a successful project, they attempt to specify performance-enhancing procedures (Tiwana & Keil, 2010). This positive effect of behavior on project performance is subject to three conditions. First, specifying performance-enhancing procedures requires the controller to be knowledgeable about the transformation process (Ouchi, 1979). The controller in hierarchical control relationships compared with market-based control relationships has a higher knowledge of the transformation

process (Henderson & Lee, 1992; Keil et al., 2013). So, the specified procedures are unlikely to be performance-enhancing in market-based control relationships.

Second, specifying procedures requires the controller to have legitimate authority over the controllee (Ouchi, 1980). Legitimate authority is higher in hierarchical control compared with market-based control relationships (Tiwana, 2008d). So, specifying procedures is not legitimate in market-based control relationships.

Third, monitoring behavior is difficult in market-based control relationships because it requires the behavior to be observable (Eisenhardt, 1985). Behavior observability is higher in hierarchical compared with market-based control relationships (Tiwana & Keil, 2010). So, monitoring behavior is easy and low cost in hierarchical but difficult and high cost in market-based control relationships. Formally:

Hypothesis 1 (H1): There is a positive effect of behavior control on IS project performance in hierarchical but not in market-based control relationships.

Outcome control requires that the controller specifies the project outcomes to be delivered by the controllee (Ouchi, 1979). IS project control literature neither argues, nor presents evidence on, why the differences should affect the controller's ability to specify and evaluate project outcomes. Instead, this literature frequently reports positive effects of outcome control on IS project performance in both hierarchical control relationships (e.g., Gopal & Gosain, 2010; Maruping et al., 2009) and market-based control relationships (e.g., Choudhury & Sabherwal, 2003; Tiwana, 2008d, 2010). Formally:

Hypothesis 2 (H2): There is a positive effect of outcome control on IS project performance in hierarchical and in market-based control relationships.

Clan control requires that the controller and the controllee share social values and beliefs (Ouchi, 1980). The assumption is that clan members share information, communicate, adopt best practices, and constantly evaluate and provide feedback on each other's work (Kirsch et al., 2010). These processes generate high levels of commitment, and mutual learning and collaboration (Gopal & Gosain, 2010), which positively affect project performance (J.-N. Lee, 2001).

We argue that this positive effect of clan control on IS project performance is higher in hierarchical compared with market-based control relationships. The non-existent organizational boundary in hierarchical control relationships facilitates the sharing of values and beliefs between the project manager and the project team members (Henderson & Lee, 1992). In contrast, the organizational boundary in market-based control relationships impedes the sharing of values and beliefs between the client representative and the project manager (Tiwana & Keil, 2010). So, clan control is more effective in hierarchical compared with market-based control relationships. Formally:

Hypothesis 3 (H3): There is a positive effect of clan control on IS project performance that is higher in hierarchical compared with market-based control relationships.

Self-control requires that the controllee specifies the goals and the actions required to achieve the goals (Kirsch & Cummings, 1996). Self-control is effective in cases where the controller

does not prescribe goals using outcome control and/or actions using behavior control (Henderson & Lee, 1992). With regard to goals, as hypothesized in H2, the controller is able to prescribe outcomes in both hierarchical and market-based control relationships. Thus, in both forms of control relationships, outcomes prescribed by the controller invalidate individual goals specified by the controllee. With regard to actions, as hypothesized in H1, the controller is able to prescribe behavior only in hierarchical control relationships. In market-based control relationships, the controller is inhibited from leveraging the controllee's superior technical expertise, granting autonomy to the controllee (Choudhury & Sabherwal, 2003). In addition, the controllee's technical expertise in market-based control relationships allows them to effectively specify their own actions (Levina & Ross, 2003). Formally:

Hypothesis 4 (H4): There is a positive effect of self-control on IS project performance in market-based but not in hierarchical control relationships.

7.3 Methodology

We adopted meta-analysis to investigate the relationship between control modes and IS project performance in hierarchical and market-based control relationships. Meta-analysis is a quantitative technique to integrate research findings from individual empirical studies (Glass, 1976; Hedges & Olkin, 1985; Hunter & Schmidt, 1990, 2004). This methodology is especially appropriate for our research because it allows us to integrate and compare research findings from existing studies that focused exclusively on either hierarchical or market-based control relationships.

7.3.1 Literature search

We searched the literature for quantitative empirical research studies reported in conference and journal papers (including forthcoming papers), dissertations, reports, and working papers. The intent of meta-analysis is to gather *all* relevant studies to estimate the true effects: the "results that would be obtained in an infinitely large, perfectly designed study or sequence of such studies" (Hunter & Schmidt, 2004, p. 31). It follows that all studies are included whether they have been published in high quality journals or whether they have been published at all. Unpublished studies are especially important to address the so-called "file-drawer problem", which refers to the issue that papers reporting non-significant results may not be published (Rosenthal, 1979). Disregarding such studies would bias the true effect. Thus, an exhaustive literature search is essential to a meta-analysis (Cooper & Hedges, 1994).

To conduct a comprehensive literature search, we adopt Webster and Watson's (2002) three step procedure: keyword search, backward search, and forward search. Although the first step may also take place in databases that contain unpublished studies (e.g., WorldCat Dissertations), this search approach is not sufficient to overcome the file-drawer problem. Therefore, recent meta-analyses in IS (e.g., Sharma & Yetton, 2007; J. Wu & Lederer, 2009) suggest a number of additional literature searches, for example sending requests in mailing lists.

Consequently, we performed four complementary literature searches to minimize the potential file-drawer validity threat. First, we conducted a systematic keyword search in the following

databases[20]: Association for Computing Machinery (ACM) Digital Library, Business Source Premier, IEEE Xplore, ProQuest ABI/INFORM, ProQuest Dissertations and Theses, Journal STORage (JSTOR), ScienceDirect, Association for Information Systems Electronic Library (AISeL), and WorldCat Dissertations and Theses[21]. The keyword search yielded 9,472 articles. Second, we conducted backward and forward searches. Backward search involves reviewing the references of the relevant studies; forward search means identifying studies that reference a relevant study (Webster & Watson, 2002). Backward searches yielded only articles that were already found in the keyword search; forward searches did not yield additional articles. Third, we searched for working papers and forthcoming journal papers by screening the websites of 56 key authors identified in the previous steps, conducting keyword searches in Google, and searching the Social Science Research Network (SSRN). This led to the inclusion of one additional article. Fourth, we sent requests for unpublished working papers on several mailing lists (e.g., AISworld and AOM OCIS) and received three replies.

To be included in our meta-analysis, each study must meet three criteria. First, the study's unit of analysis is a hierarchical or market-based control relationship in IS projects. 60 studies met the first criterion. Second, the study measures project performance and at least one control mode as defined in the previous section (i.e., behavior, outcome, clan, or self-control). 24 studies met the second criterion. Third, the study includes the statistical information required to conduct meta-analysis: the correlation coefficient between control mode and performance, and the sample size[22]. 21 studies met the third criterion.

In total, the literature search revealed 24 studies that fulfill the first two criteria. We removed three studies because they do not fulfill the third criterion and four studies because they are previous versions (e.g., conference papers, dissertations, working papers, and journal papers based on the same sample) of journal papers that are also included in the meta-analysis. In sum, our meta-analysis includes 17 studies based on 17 independent samples, reporting 86 effect sizes for a total sample size of 1,705 IS projects[23,24].

7.3.2 Coding of studies

For each study included in the meta-analysis, we extracted the following information: name and description of each variable measuring a control mode or project performance, the correlation

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[20] Following Sabherwal et al. (2006), we used one or more of several keywords related to control (i.e., "control", "formal", "informal") and one or more of several keywords related to IS projects (i.e., "information system", "information technology", "software").

[21] These databases included the major journals and conference proceedings in the IS and management discipline such as Management Information Systems Quarterly (MISQ), Information Systems Research (ISR), Journal of Management Information Systems (JMIS), Management Science (MS), Academy of Management Journal (AMJ), Strategic Management Journal (SMJ), International Conference on Information Systems (ICIS), Americas Conference on Information Systems (AMCIS), European Conference on Information Systems (ECIS), and Hawaii International Conference on System Sciences (HICSS).

[22] When these statistics were missing, we contacted the corresponding author of the study with a request to share the missing statistics with us. This lead to an inclusion of two additional studies providing five independent effect sizes.

[23] Represented in the references section by asterisks.

[24] Distributed across publication type as follows: journals (12), conference proceedings (4), dissertations (1), and working papers (2). Distributed across years as follows: 1992 (1), 1998 (1), 2006 (1), 2007 (2), 2008 (3), 2009 (3), 2010 (2), 2011 (3), 2012 (2), 2013 (1).

coefficient between each control mode and project performance, the measurement error for each variable in terms of reliability coefficients, and the sample size for the study. In addition, we coded whether the study's unit of analysis is a hierarchical or market-based control relationship.

Our coding of project performance comprises process- and product-related performance criteria[25]. Process-related performance criteria include adherence to budgets and schedules (e.g., Keil et al., 2013; G. Klein et al., 2006; S. Liu et al., 2008). Product-related performance criteria include quality of project outcomes and satisfaction with outcomes (e.g., Goo et al., 2009; Guinan & Faraj, 1998; Maruping et al., 2009). This conceptualization of project performance is consistent with the literature on IS project control (Gopal & Gosain, 2010; Henderson & Lee, 1992; Heumann, Wiener, & Remus, 2012; Srivastava & Teo, 2012).

Our coding of control modes was very restrictive. We coded a variable as behavior, outcome, clan, and self-control in cases only in which the variable was explicitly conceptualized according to Ouchi (1979) and/or Kirsch (1997)[26]. Other concepts were not coded as control. For example, goal specificity (e.g., Rasch & Tos, 1992) was not coded as outcome control, and social integration was not coded as clan control (e.g., Aladwani, 2002a). We deliberately conducted this coding restrictively to ensure that the conclusions of our results can be directly attributed to control theory in IS projects.

7.3.3 Analysis

We conducted subgroup-analyses to investigate the effects of control modes on performance in hierarchical and market-based control relationships. Therefore, the studies included in the meta-analysis were partitioned into two subgroups: hierarchical and market-based control relationships. For each subgroup, we corrected the effect sizes and calculated several meta-analytic outcomes.

Effect sizes are the "chief coins of the meta-analytic realm" (Rosenthal & DiMatteo, 2001, p. 59) and represent the unit of meta-analysis. The effect sizes were obtained in the form of zero-order Pearson product-moment-correlation coefficients, which are among the most generally accepted effect size metrics in management (e.g., Geyskens, Krishnan, Steenkamp, & Cunha, 2009) and IS literature (e.g., He & King, 2008; Joseph et al., 2007). Being a scale-free measure, correlation coefficients are easy to interpret (Rosenthal & DiMatteo, 2001). Fisher z-transformation was not applied because it creates a bias that can inflate the obtained estimates (F. L. Schmidt, Hunter, & Raju, 1988). Consequently, our meta-analytic calculations result in conservative estimates of the relationships between control and performance.

Dependent effect sizes occur when a study reports more than one correlation coefficient for a specific relationship. In these cases, we averaged the corresponding correlation coefficients (Hunter & Schmidt, 2004; Palmatier et al., 2006). This avoids biased estimates that would result from including dependent effect sizes in a meta-analysis (e.g., He & King, 2008; Palmatier et al., 2006). In total, 86 initial effect sizes were combined to 43 independent effect sizes.

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[25] As a robustness check, we conducted separate analyses for the effects of control modes on process- and product-related criteria of project performance, respectively. The results showed no significant differences.

[26] A table mapping the coded variables from each study included in the meta-analysis to the constructs is presented in the Appendix (Table 27).

The effect sizes were corrected for measurement error (Hunter & Schmidt, 2004). Specifically, each correlation coefficient was divided by the product of the square root of the reliability coefficients for the control mode and the project performance variable. If a measurement was based on a single-item or a proxy variable, we adopted a conservative standard of 0.8 for the reliability coefficient (Bommer et al., 1995; Dalton et al., 2003; Dalton et al., 1998; Dalton et al., 1999; K. Jiang et al., 2012; Sleesman et al., 2010).

We used the random-effects model developed by Hunter and Schmidt (2004), which is consistent with recent meta-analyses in IS (e.g., Joseph et al., 2007; Sabherwal et al., 2006). Weighting the correlation coefficients by sample size and reliability, we calculated the following meta-analytic outcomes for each relationship: the number of effect sizes (k), the total sample size (N), the average corrected correlation (expected rho; $\bar{\rho}$), the standard deviation of rho (SD_ρ), the 95 percent confidence interval around the expected rho ($CI_{\bar{\rho};.95}$)[27], the 80 percent credibility interval around the expected rho ($CR_{\bar{\rho};.80}$), the percentage of variance that is accounted for by statistical artifacts ($\%V$), and Cochran's (1954) chi-square test for heterogeneity (Q_{within}).

While some of the meta-analytic outcomes are self-explanatory (e.g., k and N), others might need some explanation. Regarding the expected rho, positive (negative) values indicate a tendency for higher (lower) project performance for a higher extent of the corresponding control mode. Regarding the 95 percent confidence interval around the expected rho, a confidence interval excluding zero denotes a statistical significant relationship. In contrast, if a confidence interval includes zero, the relationship is not significant. The remaining three outcomes assess the generalizability of the results. Regarding the 80 percent credibility interval around the expected rho, a credibility interval that is large or includes zero inhibits the generalizability of the expected rho. Regarding the percentage of variance that is accounted for by statistical artifacts, a value less than 75 percent suggests a heterogeneous relationship (Hunter & Schmidt, 2004). Finally, regarding Cochran's (1954) chi-square test for heterogeneity, a significant value suggests that the expected rho does not generalize.

We conducted two tests to assess whether the effects of control modes on performance are significantly different between hierarchical and market-based control relationships (Borenstein et al., 2009). First, we conducted an ANOVA-like test based on a decomposition of Cochran's (1954) chi-square statistic for heterogeneity (see, e.g., T.-Y. Park & Shaw, 2013). In the analysis reported here, a relationship with a significant $Q_{between}$-statistic is interpreted to show that the effect size is different between hierarchical and market-based control relationships. Second, we conducted a two-sample Z-test (see, e.g., Quinones et al., 1995). A relationship with a significant Z-statistic suggests that the effect size is different between hierarchical and market-based control relationships.

7.3.4 Limitations

Meta-analysis is subject to several potential validity threats. Here, we discuss four of the most frequently identified threats. First, while we conducted an extensive literature search, the possibility remains that we did not identify all relevant studies. In addition, some studies do not

[27] We used Hunter and Schmidt's (2004) formula for individually corrected correlation coefficients to calculate the standard errror of the estimated average correlations: $SE_{\bar{\rho}} = SD_r/\sqrt{k}$.

report the necessary statistics and, thus, are not included in the meta-analysis. However, considering the extensive nature of our literature search, we are confident that our results are not subject to a major validity threat from any missing studies.

Second, the file-drawer problem is a potential threat to any meta-analysis. It refers to the potential bias that the results of unpublished studies and the results of published studies are systematically different (Rosenthal, 1979). As indicated in the methodology section, our literature search includes conference papers, dissertations, and working papers. Specifically, seven of the 17 studies fall into one of these categories. Thus, we are confident that the file-drawer problem is not a major potential validity threat to our results.

Third, the meta-analytic calculations are based on a small number of effect sizes. A small number of effect sizes does not bias the estimates of the expected rhos. However, it does affect the reliability of the estimates of the standard deviation of the rhos that are used to calculate the credibility intervals (Hunter & Schmidt, 2004). Therefore, we additionally estimated Hunter and Schmidt's (2004) 75 percent rule and Cochran's (1954) chi-square test for heterogeneity. There is no evidence of bias in the findings. In addition, other meta-analyses in IS (e.g., Joseph et al., 2007) are based on a similar number of effect sizes. We conclude that the limited number of studies is not a potential major validity threat to our results.

Fourth, our meta-analytic results are corrected for only three artifacts present in individual studies: sampling error, measurement error of control modes, and measurement error of project performance. Hunter and Schmidt (2004) list eleven artifacts that can affect the value of outcome measures and specify procedures to correct for them. However, correcting for these artifacts requires statistical information that is rarely available in individual studies. Thus, these corrections are beyond the scope of this meta-analysis.

7.4 Results

The results in Table 26 support H1: *There is a positive effect of behavior control on IS project performance in hierarchical but not in market-based control relationships*. The positive effect of behavior control on IS project performance is significant in hierarchical control relationships ($\bar{\rho} = .40$, $CI_{\bar{\rho};.95} = .29$ to .52) and is non-significant in market-based control relationships ($\bar{\rho} = .16$, $CI_{\bar{\rho};.95} =$ -.03 to .36). In addition, the effect of behavior control on IS project performance is significantly higher in hierarchical compared with market-based control relationships ($Q_{between} = 14.37$*, $Z = 2.08$*).

The results in Table 26 support H2: *There is a positive effect of outcome control on IS project performance in hierarchical and in market-based control relationships*. The positive effect of outcome control on IS project performance is significant in hierarchical ($\bar{\rho} = .40$, $CI_{\bar{\rho};.95} = .28$ to .51) and market-based control relationships ($\bar{\rho} = .35$, $CI_{\bar{\rho};.95} = .24$ to .46). In addition, the effect of outcome control is not significantly different in hierarchical compared with market-based control relationships ($Q_{between} = 0.38$, $Z = 0.54$).

The results in Table 26 partially support H3: *There is a positive effect of clan control on IS project performance that is higher in hierarchical compared with market-based control relationships*. Consistent with H3, the positive effect of clan control on IS project performance

is significant in hierarchical ($\bar{\rho} = .36$, $CI_{\bar{\rho};.95} = .25$ to .46) and market-based relationships ($\bar{\rho} = .26$, $CI_{\bar{\rho};.95} = .12$ to .39). In addition, this effect is higher in hierarchical compared with market-based control relationships ($\bar{\rho} = .36$ and $\bar{\rho} = .26$, respectively). However, the difference is non-significant ($Q_{between} = 1.01$, $Z = 1.11$).

	k	N	$\bar{\rho}$	SD_ρ	$CI_{\bar{\rho};.95}$	$CR_{\bar{\rho};.80}$	%V	Q_{within}	$Q_{between}$	Z
Behavior control	13	1321	.28	.23	.14 : .42	-.01 : .57	.18	63.67*	14.37*	2.08*
– Hierarchy	5	607	.40	.09	.29 : .52	.28 : .52	.50	8.35		
– Market	8	714	.16	.26	-.03 : .36	-.16 : .49	.18	40.95*		
Outcome control	12	1100	.37	.09	.29 : .45	.26 : .49	.61	15.96	0.38	0.54
– Hierarchy	5	496	.40	.07	.28 : .51	.30 : .49	.68	5.92		
– Market	7	604	.35	.10	.24 : .46	.23 : .47	.59	9.67		
Clan control	12	936	.27	.15	.16 : .39	.08 : .47	.41	25.72*	1.01	1.11
– Hierarchy	3	174	.36	.00	.25 : .46	.36 : .36	2.11	1.20		
– Market	9	762	.26	.17	.12 : .39	.04 : .47	.35	23.51*		
Self-control	6	374	.17	.17	-.01 : .35	-.05 : .38	.46	12.09*	7.10*	2.97*
– Hierarchy	3	208	.00	.10	-.21 : .21	-.13 : .13	.70	4.18		
– Market	3	166	.35	.00	.25 : .44	.35 : .35	3.27	.81		

Notes. k: number of effect sizes; N: total sample size; $\bar{\rho}$: expected rho; SD_ρ: standard deviation of rho; $CI_{\bar{\rho};.95}$: 95% confidence interval around the expected rho; $CR_{\bar{\rho};.80}$: 80% credibility interval around the expected rho; %V: percentage of variance that is accounted for by statistical artifacts; Q_{within}: Cochran's chi-square statistic for variance in a sample or subsample; $Q_{between}$: Cochran's chi-square statistic for variance that is explained by the partitioning into subsamples; Z: Z-statistic *: p-value < 0.05.

Table 26. Effects of control on performance in hierarchical and market-based control relationships

The results in Table 26 support H4: *There is a positive effect of self-control on IS project performance in market-based but not in hierarchical control relationships*. The positive effect of self-control on IS project performance is significant in market-based control relationships ($\bar{\rho} = .35$, $CI_{\bar{\rho};.95} = .25$ to .44) and is non-significant in hierarchical control relationships ($\bar{\rho} = .00$, $CI_{\bar{\rho};.95} = -.21$ to .21). In addition, the effect of self-control is significantly higher in market-based compared with hierarchical control relationships ($Q_{between} = 7.10$*, $Z = 2.97$*).

7.5 Discussion

The results provide strong support for the general claim that the effects of control modes on IS project performance differ between hierarchical compared with market-based control relationships. Below, we begin by reviewing the findings how the effects on IS project performance of the four control modes, namely, behavior, outcome, clan, and self-control, differ between hierarchical compared with market-based control relationships. Drawing on these findings, we examine the implications for theory and practice under two headings. Under one,

we contribute to the IS project control literature on complementary and substitutive effects between control modes in hierarchical compared with market-based control relationships. Under the other, we introduce the concept of control chains to explore the interrelations among hierarchical and market-based control relationships.

7.5.1 Findings

There is a positive effect of behavior control on IS project performance in hierarchical but not in market-based control relationships (Hypothesis 1). This supports our assertion that, in market-based control relationships, the controller's low knowledge of the transformation process (Keil et al., 2013), the absence of legitimate authority over the controllee (Tiwana, 2008d), and difficulties in observing the behavior of the controllee (Tiwana & Keil, 2010) limit the controller's potential to improve project performance using behavior control.

There is a positive effect of outcome control on IS project performance in hierarchical and in market-based control relationships (Hypothesis 2). It is possible to specify and evaluate outcomes in both hierarchical control relationships (e.g., Gopal & Gosain, 2010; Maruping et al., 2009) and market-based control relationships (e.g., Choudhury & Sabherwal, 2003; Tiwana, 2008d, 2010).

Contrary to our expectations, the positive effect of clan control on IS project performance is not significantly higher in hierarchical compared with market-based control relationships (Hypothesis 3). Values and beliefs can be shared when bridging organizational boundaries (Choudhury & Sabherwal, 2003; March & Simon, 1958). However, the difference in the effect sizes (hierarchical $\bar{\rho} = .36$ compared with market-based $\bar{\rho} = .26$) indicates some support for our arguments underpinning Hypothesis 3. We would expect this difference to decrease as the number of IS projects increases that a vendor conducts for a particular client. The projects facilitate project collaboration, and increase trust and shared knowledge, between the client and the vendor (Ethiraj et al., 2005; Gefen et al., 2008).

There is a positive effect of self-control on IS project performance in market-based but not in hierarchical control relationships (Hypothesis 4). In hierarchical control relationships, deploying self-control is bounded by the frequent use of outcome and behavior control (Henderson & Lee, 1992). In market-based control relationships, granting autonomy to establish self-control leverages the vendor's (compared with the controller's) higher knowledge of the transformation process (Choudhury & Sabherwal, 2003).

7.5.2 Complementary and substitutive effects of control modes

Our results indicate complementary and substitutive effects between the control modes on IS project performance. These effects of control modes on IS project performance are contingent on the two distinct ways by which the control modes influence controllee actions. One is that control modes provide guidance to the controllee (Goo et al., 2009). The other is that control modes align the controllee's with the controller's goals (Kirsch et al., 2002).

While behavior control provides guidance to the controllee (Goo et al., 2009), outcome control aligns the controllee's with the controller's goals (Kirsch et al., 2002). Thus, behavior and outcome control have complementary effects on project performance. With regard to clan

control, our results do not allow us to draw conclusions about complementary or substitutive effects.

Self-control allows the controllee to specify their own goals and/or actions required to achieve the goals (Kirsch, 1996). Self-set goals are effective only if goals are not already prescribed by outcome control (Henderson & Lee, 1992). Thus, with regard to goals, self-control substitutes outcome control in the effect on project performance. Self-set actions are effective only if actions are not already prescribed by behavior control (Henderson & Lee, 1992). Thus, with regard to actions, self-control substitutes behavior control in the effect on project performance.

These complementary and substitutive effects between control modes on project performance have important normative implications for structuring portfolios of control, in which the controller combines complementary control modes and chooses between substitutive control modes (Choudhury & Sabherwal, 2003). Among the substitutive control modes, the controller should choose the most effective one.

The controller's choice between the substitutive options of prescribing goals to the controllee using outcome control and relying on self-set goals by the controllee using self-control is a general one. Prescribed goals by the controller are generally more effective than individual goals set by the controllee (Kirsch, 1997).

The controller's choice between the substitutive options of prescribing actions to the controllee via behavior control and relying on self-set actions by the controllee via self-control is contingent on the controller's knowledge of the transformation process. If the controller's knowledge of the transformation is high, prescribed behavior by the controller is more effective than individual actions set by the controllee (Henderson & Lee, 1992). In contrast, if the controller's knowledge of the transformation process is low, individual actions set by the controllee are more effective than prescribed behavior by the controller (Hoberg et al., 2013; Levina & Ross, 2003).

How contingency on the controller's knowledge of the transformation process influences the structure of control portfolios differs in hierarchical compared with market-based control relationships. In hierarchical control relationships, the controller's knowledge of the transformation process is high (Henderson & Lee, 1992). Thus, the controller should choose behavior control over relying on self-set actions by the controllee via self-control.

In contrast, in market-based control relationships, the controller's knowledge of the transformation process is low (Keil et al., 2013). Thus, the controller should rely on self-set actions by the controllee via self-control instead of implementing behavior control. This implication is in line with research that suggests that clients can increase the success of IS projects by focusing on leveraging the vendor's capabilities instead of tightly monitoring vendor behavior (Hoberg et al., 2013). Our results suggest that, in market-based control relationships, clients should focus on establishing outcome control but give up behavior control in favor of self-control to leverage the vendor's capabilities.

In practice, we speculate that in hierarchical relationships, the project manager should employ outcome control (set challenging goals), behavior control (establish effective project processes) and clan control (build a cohesive team with high performance norms). In market-based relationships, specifically, when outsourcing an IS project, the client representative should

employ outcome controls (negotiate challenging goals in the outsourcing contract), self-set actions (choose an experienced vendor with expertise/knowledge of similar projects) and clan control (build strong relational governance structures with the vendor).

7.5.3 Interrelations among hierarchal and market-based control relationships

As described above, outsourced IS projects are not exclusively managed by either hierarchical or market-based control relationships (Gopal & Gosain, 2010). Instead, hierarchical and market-based control relationships form a chain of control. The client representative (as the controller in the market-based control relationship) represents the initiating actor in the control chain, the project manager (as the controllee in the market-based and controller in the hierarchical control relationships) is a mediating actor, and the project team members (as the controllees in the hierarchical control relationship) are the receiving actors of the control chain (Figure 11).

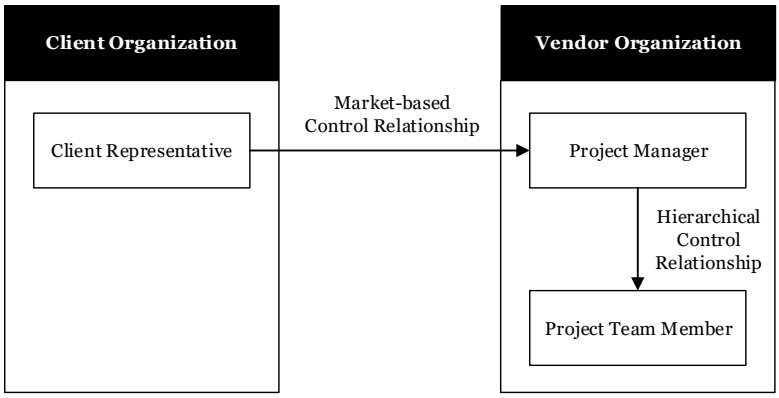

Figure 11. Mixed market-based/hierarchical control chains

To interpret our results with respect to the interrelations among hierarchical and market-based control relationships, we apply Ouchi's (1978) transmission of control framework as a theoretical lens. Here, we define transmission of control as the process by which a control mode specified by a client representative (in the market-based part of the control chain) is passed through by the vendor project manager to their project team members (in the hierarchical part of the control chain).

First, our results indicate that the behavior control mode does not transmit through the chain of control. The use of behavior control by the client representative in the market-based part of the control chain limits the vendor in leveraging their higher knowledge of the transformation process (Choudhury & Sabherwal, 2003). Bringing the vendor to deviate from established practices will decrease the vendor's ability to efficiently perform an IS project (Hoberg et al., 2013). More specifically, the vendor project manager would be limited in their ability to efficiently control the behavior of the project team members. As our results suggest, the use of behavior control by the client representative in the market-based part of the control chain has no significant effect on project performance. This result extends Ouchi's (1978) finding that behavior control does not transmit consistently through a multiple-level hierarchical control chain to mixed market-based/hierarchical control chains.

Second, our results indicate that the outcome control mode transmits through the chain of control. The project manager is able to effectively transform the client's contractually specified

outcome measures into internal outcome controls. Our results suggest that both, the use of outcome control by the client representative in the market-based part of the control chain and the use of outcome control by the project manager in the hierarchical part of the control chain have a positive effect on project performance. This result is consistent with Ouchi (1978), who finds that outcome control transmits consistently through a multiple-level hierarchical control chain. Hence, our results suggest generalizability to mixed market-based/hierarchical control chains.

Third, our results indicate that the clan control mode transmits through the chain of control. The project manager is able to effectively promulgate the client representative's values and beliefs within the existing clan in the vendor organization. Our results suggest that both, the use of clan control by the client representative in the market-based part of the control chain and the use of clan control by the project manager in the hierarchical part of the control chain have a positive effect on project performance.

Fourth, our results indicate that the self-control mode does not transmit through the chain of control. As our results suggest, the use of self-control by the project manager in the hierarchical part of the control chain has no significant effect on project performance. Instead, we assume that the positive effect of self-control on project performance in the market-based part of the control chain can be realized because granting autonomy to establish self-control enables the client to benefit from the vendor's experience from a large number of similar projects (Choudhury & Sabherwal, 2003; Levina & Ross, 2003). Thus, the vendor project manager would be enabled to efficiently control the behavior of the project team members in the hierarchical part of the control chain.

Modeling portfolios of control modes as control chains in market-based control helps to formally specify the differences and similarities between hierarchical and market-based controls. Future research should investigate extending the unit of analysis from individual control modes in a portfolio of control modes to a chain of control modes. This would involve formally modeling and testing Ouchi's (1978) concept of the transmission of control between actors.

7.6 Conclusions

This paper analyzes how the effects of control modes on IS project performance differ between hierarchical compared with market-based control relationships. Prior literature in IS project control has focused exclusively on one of these forms of control relationships. To the best of our knowledge, our study is the first to jointly investigate hierarchical and market-based control relationships. Comparing these two forms of control relationships allows us to detect differences with regard to the effectiveness of specific control modes. Building on our results, we discuss how the structure of control portfolios differs between hierarchical compared with market-based control relationships. In addition, we explore how hierarchical and market-based control relationships are interrelated.

The contributions of this study are threefold. First, we demonstrate how the effects of control modes on IS project performance differ in hierarchical and market-based control relationships. Outcome and clan control enhance IS project performance in both forms of control relationships. Behavior control enhances IS project performance only in hierarchical

control relationships, and self-control enhances IS project performance only in market-based control relationships. Our findings present a novel contribution to IS project control literature, which speculates that there are differences between forms of control relationships (Choudhury & Sabherwal, 2003; Gopal & Gosain, 2010; Kirsch et al., 2002) but does not explicitly examine the difference. We, thereby, complement prior studies that exclusively investigate either hierarchical (e.g., Henderson & Lee, 1992; Maruping et al., 2009) or market-based (e.g., Mao et al., 2008; Tiwana, 2010) control relationships in IS projects.

Second, drawing on our results, we derive implications about how the structure of control portfolios differs between hierarchical compared with market-based control relationships. These implications extend previous studies on the structure of control portfolios (Choudhury & Sabherwal, 2003; Kirsch, 1997; Tiwana, 2010) by highlighting the differences between control portfolios in hierarchical compared with market-based control relationships. In addition, extant literature predominantly focuses on the complementary and substitutive effects between formal and informal control at an aggregated level (with the notable exception of Tiwana, 2010). Our implications extend this literature by focusing on complementary and substitutive effects at the more granular level of control modes (i.e., behavior, outcome, and self-control).

The third contribution is in introducing the concept of control chains to explore the interrelations among hierarchical and market-based control relationships. An important topic that, so far, has been neglected by extant IS literature. To explore these interrelations, we adopt Ouchi's (1978) transmission of control framework as a theoretical lens. Our propositions guide future research to address important gaps in the IS project control literature.

7.7 Acknowledgements

Support for this project was provided by the German Research Foundation (DFG SCHE 1805).

7.8 Appendix

Reference	**Study variable**	**Construct**	**Justification[a]**
Beimborn, Schlosser, and Weitzel (2009)	CONTROL_REP	Outcome control	p. 2727
Beimborn et al. (2009)	CONTROL_PROV	Outcome control	p. 2727
Beimborn et al. (2009)	CONTROL_BANK	Behavior control	p. 2727
Beimborn et al. (2009)	SQ_reliability	IS project performance	Service quality
Beimborn et al. (2009)	SQ_responsiveness	IS project performance	Service quality
Goo (2010)	Service level objectives	Clan control	p. 188
Goo (2010)	Process Ownership Plan	Clan control	p. 188
Goo (2010)	Service Level Contents	Clan control	p 188

Goo (2010)	Future demand management plan	Behavior control	p. 188
Goo (2010)	Anticipated change plan	Behavior control	p. 188
Goo (2010)	Feedback plan	Behavior control	p. 189
Goo (2010)	Innovation Plan	Behavior control	p. 191
Goo (2010)	Communication plan	Outcome control	p. 189
Goo (2010)	Measurement charter	Outcome control	p. 189
Goo (2010)	Conflict Arbitration	Outcome control	p. 189
Goo (2010)	Enforcement	Outcome control	p. 192
Goo (2010)	Satisfaction with Output Quality	IS project performance	Goo and Nam (2007, p. 243)
Gopal and Gosain (2010)	Software process control	Behavior control	p. 965
Gopal and Gosain (2010)	Outcome control-quality	Outcome control	
Gopal and Gosain (2010)	Outcome control-efficiency	Outcome control	
Gopal and Gosain (2010)	Collaborative culture (clan)	Clan control	p. 967
Guinan and Faraj (1998)	Team Self-Control	Self-control	
Guinan and Faraj (1998)	Team Performance	IS project performance	
Haney (2009)	Behavior Control	Behavior control	
Haney (2009)	Outcome Control	Outcome control	
Haney (2009)	Clan Control	Clan control	
Haney (2009)	Product Performance	IS project performance	
Haney (2009)	Resource Overruns	IS project performance	Reverse coded
Henderson and Lee (1992)	Managerial Outcome Control	Outcome control	
Henderson and Lee (1992)	Managerial Behavior Control	Behavior control	
Henderson and Lee (1992)	Team-Member Self-Control	Self-control	

Henderson and Lee (1992)	Team-Member Outcome Control	Clan control	p. 760
Henderson and Lee (1992)	Efficiency	IS project performance	
Henderson and Lee (1992)	Effectiveness	IS project performance	
Heumann et al. (2012)	Clan Control	Clan control	
Heumann et al. (2012)	Self-Control	Self-control	
Heumann et al. (2012)	IS Offshoring Project Performance	IS project performance	
Keil et al. (2013)	Behavioral control	Behavior control	
Keil et al. (2013)	Outcome control	Outcome control	
Keil et al. (2013)	Clan control	Clan control	
Keil et al. (2013)	Self-control	Self-control	
Keil et al. (2013)	Process performance	IS project performance	
G. Klein et al. (2006)	Project performance	IS project performance	
G. Klein et al. (2006)	Management behavioral control	Behavior control	
G. Klein et al. (2006)	Management outcome control	Outcome control	
J. Y.-C. Liu, Chen, Chan, and Lie (2008)	Software process standardization	Behavior control	p. 891
J. Y.-C. Liu et al. (2008)	Project performance	IS project performance	
Mao et al. (2008)	Control	Behavior control	p. 490
Mao et al. (2008)	Project quality	IS project performance	p. 491
Mao et al. (2008)	Cost control	IS project performance	p. 491
Maruping et al. (2009)	Outcome control	Outcome control	
Maruping et al. (2009)	Self control	Self-control	
Maruping et al. (2009)	Component complexity	IS project performance	Reverse coded
Maruping et al. (2009)	Coordinative complexity	IS project performance	Reverse coded
Maruping et al. (2009)	Dynamic complexity	IS project performance	Reverse coded

Nagpal et al. (2012)	Clan controls	Clan control	
Nagpal et al. (2012)	Specialized Behavior controls	Behavior control	
Nagpal et al. (2012)	General Outcome controls	Outcome control	
Nagpal et al. (2012)	Specialized Outcome controls	Outcome control	
Nagpal et al. (2012)	Modularity	IS project performance	p. 10
Srivastava and Teo (2012)	Relational governance	Clan control	p. 123
Srivastava and Teo (2012)	Quality performance	IS project performance	
Srivastava and Teo (2012)	Cost performance	IS project performance	
Tiwana (2010)	Systems development ambidexterity	IS project performance	p. 125
Tiwana (2010)	Outcome control	Outcome control	
Tiwana (2010)	Behavior control	Behavior control	
Tiwana (2010)	Clan control	Clan control	
Tiwana and Keil (2007)	Relational governance	Clan control	p. 628
Tiwana and Keil (2007)	Outcome control	Outcome control	
Tiwana and Keil (2007)	Process control	Behavior control	p. 625
Tiwana and Keil (2007)	Alliance performance	IS project performance	
Wiener, Remus, and Mähring (2012)	Clan control	Clan control	
Wiener et al. (2012)	Behavior control	Behavior control	
Wiener et al. (2012)	Outcome control	Outcome control	
Wiener et al. (2012)	Project performance	IS project performance	

Notes. [a]: In cases where the mapping is not immediately obvious from the study variable name, we included the page number of the reference in which the author(s) of the reference conceptualize the study variable according to Ouchi (1979) and/or Kirsch (1997).

Table 27. Mapping of study variables to constructs

No.	Reference	Form of control relationship
1	Beimborn et al. (2009)	market-based
2	Goo (2010)	market-based
3	Gopal and Gosain (2010)	hierarchical
4	Guinan and Faraj (1998)	hierarchical
5	Haney (2009)	hierarchical
6	Henderson and Lee (1992)	hierarchical
7	Heumann et al. (2012)	market-based
8	Keil et al. (2013)	market-based
9	G. Klein et al. (2006)	hierarchical
10	J. Y.-C. Liu et al. (2008)	hierarchical
11	Mao et al. (2008)	market-based
12	Maruping et al. (2009)	hierarchical
13	Nagpal et al. (2012)	market-based
14	Srivastava and Teo (2012)	market-based
15	Tiwana (2010)	market-based
16	Tiwana and Keil (2007)	market-based
17	Wiener et al. (2012)	market-based

Table 28. Studies included in the analysis of S3

8 Determinants of IS project performance[28]

Title	What determines information systems project performance? A narrative review and meta-analysis
Authors	Dongus, Konrad (konrad.dongus@in.tum.de) Ebert, Simon (simon.ebert@in.tum.de) Schermann, Michael (michael.schermann@in.tum.de) Krcmar, Helmut (krcmar@in.tum.de) Technische Universität München Chair for Information Systems Boltzmannstraße 3 85748 Garching bei München Germany
Outlet	48th Hawaii International Conference on System Sciences 2015
Abstract	This study employs both a narrative review and a meta-analysis to review the determinants of information systems (IS) project performance. As a result of the narrative review, we present a framework of 22 conceptually distinct determinants of IS project performance classified into six categories. Using meta-analytic techniques, we quantitatively aggregate the empirical findings within this framework. The results show that the determinants trust, coordination, and knowledge integration have the strongest effect on IS project performance. In contrast, the determinants project size, IS team size, and technological uncertainty have the weakest effect on IS project performance. This review consolidates the understanding of IS project performance and provides avenues for further research.
Keywords	-
Individual contribution	Ideation, data preparation, data analysis, interpretation of results, and manuscript writing

Table 29. Bibliographic details for S4

[28] Originally published as: Dongus, K., Ebert, S., Schermann, M., & Krcmar, H. (2015). *What determines information systems project performance? A narrative review and meta-analysis*. Paper presented at the 48th Hawaii International Conference on System Sciences, Kauai, HI.

8.1 Introduction

The management of information systems (IS) projects remains one of the most crucial challenges for organizations (Gopal & Gosain, 2010; Keil et al., 2013). After more than four decades of IS project management, recent industry studies report that IS projects still fail to meet efficiency objectives and quality expectations (Bloch et al., 2012; Flyvbjerg & Budzier, 2011; The Standish Group, 2013). For example, The Standish Group (2013) reports that only 39% of IS projects are delivered on time, on budget, and with the specified features and functions.

In response to these challenges, research has investigated the determinants of IS project performance in over 230 empirical research studies. However, as these studies typically examine subsets of determinants, the extensive body of literature is highly fragmented. There is no comprehensive review of this literature to classify the already investigated determinants and compare their relative effect strengths on IS project performance. For this purpose, we employ both narrative and meta-analytic techniques to review this extensive but fragmented body of literature.

This paper consists of two main parts. In the first part, we present a narrative review of the literature to identify and classify previously researched determinants of IS project performance into a comprehensive framework. In the second part, we present a meta-analysis that quantitatively aggregates the existing empirical findings within this framework of determinants.

The remainder of this paper proceeds as follows. In section 2, we present the procedure and the results of the narrative review. In section 3, we present the procedure and the results of the meta-analysis. In section 4, we discuss the study's results. In section 5, we present the limitations. We provide our conclusive remarks in the paper's final section.

8.2 Narrative review

8.2.1 Procedure

We conducted three complementary literature searches to minimize the potential of missing relevant studies. First, we conducted a systematic keyword search in the following databases: Business Source Premier, JSTOR, ScienceDirect, ABI/INFORM, ACM Digital Library, IEEE Xplore, The Association for Information System Electronic Library (AISeL), ProQuest Dissertations and Theses, WorldCat Dissertations and Theses. Following Sabherwal et al. (2006), we used one or more of several keywords related to IS projects (i.e., "software", "information system", "information technology", "project") and one or more of several keywords related to project performance (i.e., "success", "performance", "satisfaction") and their variants (e.g., "successful"). Second, we conducted backward and forward searches (Webster & Watson, 2002). Third, we searched for working papers and forthcoming journal papers by screening the websites of key authors identified in the previous steps, conducting keyword searches in Google, and searching the Social Science Research Network (SSRN).

Our sample consists of 238 empirical research studies reported in journals, conference proceedings, dissertations, working papers, and forthcoming journal papers. We included conference papers, dissertations and working papers to address the so-called "file-drawer

problem", which refers to the issue that unpublished studies may systematically report different results than published studies (Rosenthal, 1979).

Based on these 238 studies, we identified and classified the most frequently investigated determinants of IS project performance. Since existing literature uses different aliases for the same determinant or similar names for conceptually different determinants, we adopted a single definition for each determinant to classify prior research results (Table 30). To ensure clarity and to meet space constraints, we included a determinant only if its effect on IS project performance was examined at least ten times in prior literature.

In total, we identified 22 conceptually distinct determinants fulfilling this precondition. We organized these determinants into six categories. The next section briefly describes each category and the effects of the included determinants on IS project performance.

8.2.2 Results

The results of the narrative review are the determinants of IS project performance. IS project performance comprises process- and product-related performance criteria. Process-related performance criteria include adherence to budgets and schedules (e.g., Henderson & Lee, 1992; Keil et al., 2013; G. Lee & Xia, 2010). Product-related performance criteria include quality of project outcomes and satisfaction with outcomes (e.g., Gopal & Gosain, 2010; Maruping et al., 2009; Poppo & Zenger, 2002). This conceptualization of project performance is consistent with the literature on IS projects (e.g., Barki & Hartwick, 2001; Faraj & Sproull, 2000; Gopal & Gosain, 2010). Table 30 contains the definition for each determinant of IS project performance. In the following, the determinants and their expected effect on IS project performance are described in more detail for each category.

Determinants	**Definitions**
Project characteristics	
Technological uncertainty	Uncertainty that stems from low experience with the technologies employed in the project (Nidumolu, 1995)
Requirements uncertainty	Uncertainty regarding the user's requirements (Nidumolu, 1995)
Technological complexity	Multiplicity and interdependence between different elements of the solution (Xia & Lee, 2005)
Organizational complexity	Multiplicity and interdependence between different elements of the organizational environment (Xia & Lee, 2005)
Project size	Size of the project
IS team characteristics	
IS team size	Size of the IS team
IS team capabilities	IS team's competence in designing and delivering IS solutions for users (Weigelt, 2013)

IS team diversity	Distribution of differences among IS team members (Harrison & Klein, 2007)
IS team autonomy	Authority of the IS team in making decisions to carry out the IS project (G. Lee & Xia, 2010; Xia & Lee, 2005)
User characteristics	
User capabilities	User's IS competence and experience with IS projects (Bharadwaj, 2000; Gopal et al., 2003)
User/IS team relationship characteristics	
Prior interactions	Extent of the relationship between the user and the IS team in the past (Kalnins & Mayer, 2004)
Relational processes	
Communication	Frequency, informality, openness, and structure of the information exchange (Hoegl & Gemuenden, 2001)
Coordination	Structure and synchronization of individual contributions within the project (Hoegl & Gemuenden, 2001)
Mutual support	Intensive collaboration between individuals based on cooperation and joint action (Hoegl & Gemuenden, 2001)
Cohesion	Desire of team members to remain on the team (Cartwright, 1968)
Knowledge integration	Melding of individually held information and know-how into a common stock of knowledge (V. L. Mitchell, 2006)
Trust	Belief in and willingness to depend on another individual (R. C. Mayer, Davis, & Schoorman, 1995)
Management Support	Managers' favorable attitude toward and explicit support for the project (Doll, 1985)
User Participation	Activities and behaviors of the user during the IS project (Barki & Hartwick, 2001)
Formal processes	
Outcome formalization	Use of standardized performance criteria applied to the IS team (Nidumolu & Subramani, 2003)
Coordination formalization	Use of authorized entities to coordinate the interaction between the IS team and the user (Nidumolu, 1995)
Development process formalization	Use of standardized rules and procedures to guide the IS team (Kim & Umanath, 1993)

Table 30. Classification of determinants

Project-related characteristics. This category contains determinants of IS project performance that are related to the project and the task of the project: technological uncertainty, requirements uncertainty, technological complexity, organizational complexity, and project size. These determinants are expected to have a negative effect on IS project performance. Uncertainty and complexity are ex ante risks in IS projects and, thus, negatively affect the performance of the IS project (Harter et al., 2000; Nidumolu, 1995). Ethiraj et al. (2005) argue that larger IS projects are harder to manage because of problems such as increased forecasting difficulties and employee attrition. In addition, project size is highly correlated with uncertainty and complexity.

IS team characteristics. This category contains determinants of IS project performance that are related to the IS development team: IS team size, IS team capabilities, IS team diversity, and IS team autonomy. IS team size is expected to have a negative effect on project performance because larger teams frequently involve coordination and project management problems (Espinosa, Slaughter, Kraut, & Herbsleb, 2007). In contrast, literature frequently reports a positive effect of IS team capabilities on project performance (e.g., Akgün, Keskin, Byrne, & Imamoglu, 2007; Huckman, Staats, & Upton, 2009; J. Y.-C. Liu, Chen, Jiang, & Klein, 2010). In addition, autonomous teams are expected to work more effectively and efficiently (Janz & Prasarnphanich, 2009). Literature is inconclusive about the effect of IS team diversity on project performance (Liang, Liu, Lin, & Lin, 2007; Lin, Hsu, Cheng, & Wu, 2012).

User-related characteristics. This category contains determinants of IS project performance that are related to the user: user capabilities. User capabilities is expected to have a positive effect on project performance because capable users are able to specify their requirements and evaluate whether the IS team meets the specified requirements (Hsu, Lin, Zheng, et al., 2012).

User/IS team-related characteristics. This category contains determinants of IS project performance that are related to the relationship between the user and the IS team: prior interactions between the user and the IS team. Prior interactions are expected to have an effect on project performance and are frequently included as control variable (e.g., Ethiraj et al., 2005; Gopal & Gosain, 2010; Rai et al., 2009).

Relational processes. This category contains determinants of IS project performance that are related to relational processes that occur within the project: communication, coordination, mutual support, cohesion, knowledge integration, trust, management support, and user participation. According to Hoegl and Gemuenden (2001), relational processes are a driving factor of project performance. Thus, determinants that relate to relational processes should have a positive effect on project performance.

Formal processes. This category contains determinants of IS project performance that are related to formal processes that occur within the project: outcome formalization, coordination formalization, and development process formalization. These determinants are expected to have a positive effect on project performance. This is because formal processes reduce the uncertainty and complexity of IS projects through clearly specified goals and procedures as well as coordination mechanisms (Mao et al., 2008; Nidumolu & Subramani, 2003; Patnayakuni, Ruppel, & Rai, 2006).

8.3 Meta-analysis

8.3.1 Procedure

Our meta-analysis sample consists of 157 studies. We dropped 81 studies from the 238 studies identified in the narrative review because they did not provide the statistics required for conducting a meta-analysis (correlation coefficients between IS project performance and its determinants, and the underlying sample size) or because they did not investigate one of the 22 conceptually distinct determinants. If a study reports more than one variable related to the same conceptual determinant, we averaged the corresponding effect sizes (Hunter & Schmidt, 2004). This is a common procedure to avoid biased estimates that could result from including dependent effect sizes in a meta-analysis (e.g., Dekker & Van den Abbeele, 2007; Palmatier et al., 2006).

Thereby, 1226 initial effect sizes were combined to 435 independent effect sizes. In total, this meta-analysis includes 157 studies providing 435 independent effect sizes based on a total sample size of 22,150 IS projects.

The effect sizes were obtained in the form of zero-order Pearson product-moment-correlation coefficients. The correlation coefficient is the most frequently used effect size in meta-analyses in IS (e.g., Dekker & Van den Abbeele, 2007; Joseph et al., 2007; Sharma et al., 2009; J. Wu & Lederer, 2009) and is, as a scale-free measure, easy to interpret (Rosenthal & DiMatteo, 2001). We did not apply Fisher's z transformation to the correlation coefficients because this results in an upward bias that is usually larger than the downward bias that results from using untransformed correlation coefficients (Hall & Brannik, 2002; Hunter & Schmidt, 2004). Thus, our meta-analytic calculations result in rather conservative estimates of the relationships between IS project performance and its determinants.

We corrected the effect sizes for measurement error to achieve more accurate estimates of the true effects and to facilitate more reliable statistical inference. Every individual study is subject to measurement error that attenuates the estimated effects (Hunter & Schmidt, 2004). We followed the approach outlined by Hunter and Schmidt (2004) to correct the effect sizes individually for error in the measurement of IS project performance and the determinants: we divided the correlation coefficients by the product of the square root of the reliability coefficients of the measurement of IS project performance and the determinant. If a measurement was based on a single-item or a proxy variable, we adopted a conservative standard of 0.8 for the reliability coefficient (Bommer et al., 1995; Dalton et al., 2003; Dalton et al., 1998; Dalton et al., 1999; K. Jiang et al., 2012; Sleesman et al., 2010).

Consistent with recent meta-analyses in IS (e.g., Joseph et al., 2007; Sabherwal et al., 2006), we used the Hunter and Schmidt (2004) random effects model to estimate the bivariate effects between IS project performance and each determinant.

8.3.2 Results

The meta-analytic results for the bivariate relationships between IS project performance and its determinants are presented in Table 31. Below, we summarize the results in order of determinant classification and whether they have a positive or negative effect on IS project performance.

Determinants	k	N	$\bar{\rho}$	SD_ρ	$CI_{\bar{\rho};.95}$	$CR_{\bar{\rho};.80}$	%V	Q
Project characteristics								
Technological uncertainty	23	4,919	.04	.23	-.06 : .14	-.25 : .33	.12	194.90*
Requirements uncertainty	30	4,925	-.20	.27	-.31 : -.10	-.55 : .15	.10	281.84*
Technological complexity	24	5,382	-.12	.22	-.21 : -.02	-.39 : .16	.13	186.58*
Organizational complexity	10	1,855	-.27	.28	-.46 : -.09	-.64 : .09	.08	108.65*
Project size	34	7,314	-.08	.14	-.14 : -.03	-.26 : .09	.27	124.41*
IS team characteristics								
IS team size	22	3,471	-.06	.11	-.12 : .00	-.21 : .08	.43	50.71*
IS team capabilities	41	8,253	.25	.22	.18 : .32	-.03 : .54	.11	328.57*
IS team diversity	11	2,072	.21	.30	.03 : .39	-.17 : .59	.08	138.32*
IS team autonomy	17	1,692	.21	.15	.12 : .30	.01 : .41	.36	44.06*
User characteristics								
User capabilities	15	2,392	.23	.14	.15 : .31	.05 : .40	.28	48.90*
User/IS team relationship characteristics								
Prior interactions	18	3,983	.14	.06	.09 : .18	.06 : .22	.63	27.88*
Relational processes								
Communication	19	3,431	.45	.14	.38 : .52	.27 : .63	.22	63.11*
Coordination	12	2,264	.50	.18	.39 : .61	.27 : .73	.14	58.51*
Mutual support	13	1,646	.44	.09	.37 : .51	.32 : .56	.46	20.58
Cohesion	16	2,147	.28	.21	.17 : .39	.01 : .55	.17	82.79*
Knowledge integration	22	3,589	.47	.19	.38 : .55	.23 : .71	.14	112.70*
Trust	11	1,801	.52	.24	.37 : .67	.21 : .83	.08	85.59*
Management support	10	1,600	.42	.14	.31 : .52	.23 : .60	.25	31.14*
User participation	25	4,182	.39	.21	.31 : .48	.13 : .66	.13	151.86*
Formal processes								
Outcome formalization	29	4,051	.37	.17	.30 : .44	.15 : .59	.21	111.42*
Coordination formalization	14	2,395	.35	.17	.25 : .45	.13 : .58	.17	66.50*

Development process formalization	19	2,022	.30	.11	.23 : .37	.16 : .44	.46	35.74*

Notes. k: number of effect sizes; N: total sample size; $\bar{\rho}$: expected rho; SD_ρ: standard deviation of rho; $CI_{\bar{\rho};.95}$: 95% confidence interval around the expected rho; $CR_{\bar{\rho};.80}$: 80% credibility interval around the expected rho; $\%V$: percentage of variance that is accounted for by statistical artifacts; Q: Cochran's chi-square statistic for heterogeneity; *: p-value of $Q < 0.05$.

Table 31. Meta-analytic results

Project characteristics. Most of the project characteristics are negatively associated with IS project performance. These include requirements uncertainty ($\bar{\rho}$ = -.20, $CI_{\bar{\rho};.95}$ = -.31 to -.10), technological complexity ($\bar{\rho}$ = -.12, $CI_{\bar{\rho};.95}$ = -.21 to -.02), organizational complexity ($\bar{\rho}$ = -.27, $CI_{\bar{\rho};.95}$ = -.46 to -.09), and project size ($\bar{\rho}$ = -.08, $CI_{\bar{\rho};.95}$ = -.14 to -.03). Technological uncertainty has a marginal positive but non-significant effect on project performance ($\bar{\rho}$ = .04, $CI_{\bar{\rho};.95}$ = -.06 to .14).

IS team characteristics. In terms of IS team characteristics, those positively associated with IS project performance include IS team capabilities ($\bar{\rho}$ = .25, $CI_{\bar{\rho};.95}$ = .18 to .32), IS team diversity ($\bar{\rho}$ = .21, $CI_{\bar{\rho};.95}$ = .03 to .39), and IS team autonomy ($\bar{\rho}$ = .21, $CI_{\bar{\rho};.95}$ = .12 to .30). Team size, on the other hand, is negatively associated with IS project performance ($\bar{\rho}$ = -.06, $CI_{\bar{\rho};.95}$ = -.12 to .00).

User characteristics. User capabilities are positively associated with IS project performance ($\bar{\rho}$ = .23, $CI_{\bar{\rho};.95}$ = .15 to .31).

User/IS team characteristics. Prior interactions are positively associated with IS project performance ($\bar{\rho}$ = .14, $CI_{\bar{\rho};.95}$ = .09 to .18).

Relational processes. All relational processes are positively associated with IS project performance. These include communication ($\bar{\rho}$ = .45, $CI_{\bar{\rho};.95}$ = .38 to .52), coordination ($\bar{\rho}$ = .50, $CI_{\bar{\rho};.95}$ = .39 to .61), mutual support ($\bar{\rho}$ = .44, $CI_{\bar{\rho};.95}$ = .37 to .51), cohesion ($\bar{\rho}$ = .28, $CI_{\bar{\rho};.95}$ = .17 to .39), knowledge integration ($\bar{\rho}$ = .47, $CI_{\bar{\rho};.95}$ = .38 to .55), trust ($\bar{\rho}$ = .52, $CI_{\bar{\rho};.95}$ = .37 to .67), management support ($\bar{\rho}$ = .42, $CI_{\bar{\rho};.95}$ = .31 to .52), and user participation ($\bar{\rho}$ = .39, $CI_{\bar{\rho};.95}$ = .31 to .48).

Formal processes. All formal processes are positively associated with IS project performance. These include outcome formalization ($\bar{\rho}$ = .37, $CI_{\bar{\rho};.95}$ = .30 to .44), coordination formalization ($\bar{\rho}$ = .35, $CI_{\bar{\rho};.95}$ = .25 to .45), and development process formalization ($\bar{\rho}$ = .30, $CI_{\bar{\rho};.95}$ = .23 to .37).

8.4 Discussion

The purpose of our study was twofold. The first purpose of this study was to identify and classify the most frequently investigated determinants of IS project performance. Drawing on this comprehensive classification, we discuss the current state of research with regard to the various determinants. The second purpose was to combine the existing empirical evidence on

the relationships between IS project performance and the identified determinants using meta-analytic techniques. Drawing on these meta-analytic results, we discuss the relative influence of the determinants on IS project performance.

8.4.1 Current state of research on IS project performance determinants

Project characteristics are among the most frequently studied determinants of IS project performance. For example, project size and requirements uncertainty have been studied in over 30 independent samples. Characteristics of the project or of the task of the project have been studied from the early beginning of IS project research, and scholars agree on their negative effect on IS project performance (e.g., Nidumolu, 1996c; Rai & Al-Hindi, 2000; Saarinen & Sääksjärvi, 1992). In more recent studies, project characteristics have been frequently included as control variables when investigating the effect of other determinants on IS project performance (e.g., Akgün, Lynn, Keskin, & Dogan, 2014; Rai, Keil, et al., 2012; Srivastava & Teo, 2012). One exception is organizational complexity. With growing globalization of knowledge work and the increasing importance of IS outsourcing, organizational complexity has become an important research topic in recent years (e.g., Langer, Mani, & Srikanth, 2013; Ramasubbu et al., 2008; Staats, 2012). Interestingly, the effect of technological complexity is non-significant but exhibits a significant degree of heterogeneity. Thus, future research should differentiate IS project types in which technological uncertainty matters for IS project performance form types in which is does not matter.

Characteristics of the participating parties in the project (IS team and user characteristics) have been studied to a moderate degree with the exception of IS team capabilities. Being investigated in 42 independent studies, researchers placed an emphasis on the capabilities of the IS team and their effect on IS project performance (e.g., Faraj & Sproull, 2000; Iacovou, Thompson, & Smith, 2009; Rai et al., 2009). Within these categories, the determinants IS team capabilities, IS team diversity, IS team autonomy, and user capabilities have a positive effect on IS project performance. Only IS team size indicates a negative but marginally non-significant effect on IS project performance. Besides the characteristics that are attached to either the IS team or the users, researchers have investigated prior interactions as a characteristic of the IS team/user relationship. The results show that prior interactions are positively related to IS project performance.

The category relational processes represents the highest number of unique determinants. Researchers investigated relational processes on different levels of abstraction. Consider for example communication. On the lowest level of abstraction, some studies examine different aspects of communication, such as frequency or informality, on a detailed level (e.g., J.-G. Park & Lee, 2014; Patnayakuni, Rai, & Tiwana, 2007). Other studies examine communication quality as a composite construct including a variety of communication aspects (e.g., Iacovou et al., 2009; Y. Lu, Xiang, Wang, & Wang, 2011; Mao et al., 2008). On the highest level of abstraction, some studies combine the communication quality with other relational processes, such as coordination and mutual support, to second-order composite constructs such as teamwork quality (e.g., Gelbard & Carmeli, 2009; Hoegl, Parboteeah, & Gemuenden, 2003; Hsu, Chang, Klein, & Jiang, 2011). Regarding the level of abstraction, we present the relational processes on the level of first order composite construct, which leads to a moderate number of studies examining each determinant. All relational processes are positively related to IS project performance. However, differences in the effects of those relational processes at different levels

of abstraction are unclear. Future research should further work on clear conceptual relations and distinctions between those relational processes on different levels of abstraction. Besides these relational processes, all three formal processes are positively related to IS project performance.

8.4.2 Relative effect strengths of IS project performance determinants

Table 32 summarizes the effect strengths of the 22 investigated determinants on IS project performance. The rank of a determinant results from its effect strength on project performance. Specifically, the determinants are in descending order of absolute effect strength. In addition, the determinants are linked to their categories in order to compare the effect strengths of the categories on IS project performance. Relational and formal processes span the first ten ranks. IS team characteristics span rank 13 to 16 (with the exception of IS team size on rank 21). The only user characteristic has rank 14, and the only IS team/user characteristic has rank 18. Finally, project characteristics span rank 17 to 22 (with the exception of organizational complexity on rank 12).

R	CA	Determinant	Effect	R	CA	Determinant	Effect
1	RP	Trust	.52	12	PC	Organizational complexity	-.27
2	RP	Coordination	.50	13	TC	IS team capabilities	.25
3	RP	Knowledge integration	.47	14	UC	User capabilities	.23
4	RP	Communication	.45	15	TC	IS team autonomy	.21
5	RP	Mutual support	.44	16	TC	IS team diversity	.21
6	RP	Management support	.42	17	PC	Requirements uncertainty	-.20
7	RP	User participation	.39	18	RC	Prior interactions	.14
8	FP	Outcome formalization	.37	19	PC	Technological complexity	-.12
9	FP	Coordination formalization	.35	20	PC	Project size	-.08
10	FP	Development process formalization	.30	21	TC	IS team size*	-.06
11	RP	Cohesion	.28	22	PC	Technological uncertainty*	.04

Notes. R: rank; CA: category; RP: relational processes; FP: formal processes; PC: project characteristics; TC: IS team characteristics; UC: user characteristics; RC: user/IS team relationship characteristics; *: non-significant effect.

Table 32. Ranking of determinants by effect strength

Comparing the effect strengths of the determinants on IS project performance reveals some interesting patterns. First, the results suggest that project management through relational and

formal processes has a higher effect on IS project performance than ex ante characteristics and risks (related to the IS team, the user, the IS team/user relationship, and the project). This finding is in line with IS outsourcing and IS project management literature. Within this literature, researchers frequently report a positive effect of partnership quality on IS project performance (e.g., Barki & Hartwick, 2001; Hoegl & Gemuenden, 2001; J.-N. Lee & Kim, 1999; Rai et al., 2009). Specifically, we provide direct evidence for Rai et al.'s (2009)'assertion that IS projects need to be managed not only with a focus on project characteristics but also with a focus on relational processes such as trust, knowledge integration, and mutual support. We extend this assertion and state that IS projects need to be managed with a strong focus on relational processes. Indeed, our results allow us to speculate that even IS projects with high ex ante risks and uncertainties might be successful in the end if effective relational and formal processes during the project are in place.

Second, the results suggest that relational processes have a higher effect on IS project performance than formal processes. This finding adds to the ongoing debate about whether relational and formal processes function as complements or substitutes. On the one hand, for example, Rai, Keil, et al. (2012) report substitutive effects between relational and formal processes. Specifically, they find that trust, knowledge integration, and mutual support substitute outcome formalization and development processes formalization. On the other hand, for example, Poppo and Zenger (2002) report a complementary relationship between relational and formal processes. Even though we did not directly test for interaction effects between relational and formal processes, our results suggest that relational processes complement rather than substitute formal processes. This is because both relational and formal processes have a significant positive effect on IS project performance.

Third, the results suggest that characteristics related to the IS team, the user, and their relationship have a higher effect on IS project performance than characteristics related to the project. This is in line with literature that highlights the importance of team capabilities (e.g., Faraj & Sproull, 2000; Harter et al., 2000; Huckman et al., 2009) and user capabilities (e.g., Hsu, Lin, Zheng, et al., 2012; Tesch, Sobol, Klein, & Jiang, 2009; Tiwana, 2009). In addition, our results reflect the somewhat ambiguous relationship of some project characteristics with IS project performance. Specifically, project size and technological uncertainty have only a marginal effect on project performance.

8.5 Limitations

This study is subject to several limitations. First, we were not able to include all available empirical research studies on IS project performance. This is a common problem to all meta-analyses. Although we conducted an extensive literature search, the possibility remains that we did not find all existing studies. Furthermore, some of the studies known to us did not report the necessary statistics and are, thus, not included in the meta-analysis. However, considering our relatively comprehensive sample and the nature of our results, we are confident that adding a few studies would not substantially affect our results.

Second, again common to all meta-analyses, there is the file-drawer problem (Rosenthal, 1979), which refers to the possible bias that the results of unpublished studies differ systematically from the results of published studies. We searched extensively for conference papers, dissertations, and working papers to address this issue. Since 24 percent of the included

individual studies stem from these sources, we are confident that the file-drawer problem does not affect our study.

Third, we only corrected our results for the three statistical artifacts that are present in every individual study: sampling error, measurement error of the determinant, and measurement error of IS project performance. Hunter and Schmidt (2004) do also provide procedures to correct for statistical artifacts that are not present in every individual study such as range restriction and dichotomization of continuous variables. However, information that must be extracted from the individual studies to correct for these artifacts is rarely available and, thus, beyond the scope of this meta-analysis.

Fourth, the meta-analytic model used in this paper does not allow for testing interaction effects between the determinants. With regard to determinants such as project size and uncertainty, interaction effects are likely to exist. Advanced meta-analytic techniques such as meta-analytic structural equation modeling are required to test interaction effects between the determinants. However, testing meta-analytic models would be beyond the scope of this paper. Instead, we encourage future research to test meta-analytic models that account for interaction effects.

8.6 Conclusion

The aim of this study was to review and consolidate the extensive but fragmented body of literature on the determinants of IS project performance. Despite the vast number of empirical research articles on this topic, there is no comprehensive integration of this literature. By employing narrative and meta-analytic techniques, our study offers two contributions to the IS project management literature. Our first contribution is in identifying and classifying the most frequently investigated determinants of IS project performance. Based on a review of 238 research studies, we identified 22 conceptually distinct determinants and classified them into six categories. Our second contribution is in analyzing the relative effect strengths of the identified determinants on IS project performance. Our results clearly show that relational and formal processes dominate user, IS team, relationship and project characteristics with regard to their effects on IS project performance.

8.7 Acknowledgements

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8.8 Appendix[29]

No.	Reference	Included in MA
1	Cusumano and Kemerer (1990)	
2	Henderson and Lee (1992)	Yes

[29] The studies included in the meta-analysis are represented by asterisks.

3	Saarinen and Sääksjärvi (1992)	Yes
4	Leonard-Barton and Sinha (1993)	Yes
5	Robey, Smith, and Vijayasarathy (1993)	Yes
6	Sonnentag, Frese, Stolte, Heinbokel, and Brodbeck (1994)	Yes
7	Deephouse, Mukhopadhyay, Goldenson, and Kellner (1995)	
8	Nidumolu (1995)	Yes
9	Grover et al. (1996)	
10	Heinbokel, Sonnentag, Frese, Stolte, and Brodbeck (1996)	Yes
11	Jones and Harrison (1996)	
12	Nidumolu (1996a)	Yes
13	Nidumolu (1996c)	Yes
14	Saleem (1996)	
15	Sonnentag, Frese, Brodbeck, and Heinbokel (1997)	Yes
16	Gobeli, Koenig, and Bechinger (1998)	Yes
17	Guinan and Faraj (1998)	Yes
18	M. S. Krishnan (1998)	Yes
19	Poppo and Zenger (1998)	Yes
20	J. J. Jiang and Klein (1999)	
21	Banerjee and Duflo (2000)	
22	Banker and Slaughter (2000)	
23	Domberger, Fernandez, and Fiebig (2000)	
24	Faraj and Sproull (2000)	Yes
25	Gopal et al. (2003)	
26	Harter et al. (2000)	Yes
27	J. J. Jiang and Klein (2000)	
28	M. S. Krishnan, Kriebel, Kekre, and Mukhopadhyay (2000)	
29	Oz and Sosik (2000)	Yes
30	Rai and Al-Hindi (2000)	Yes
31	Yetton et al. (2000)	Yes

32	Barki and Hartwick (2001)	
33	Barki et al. (2001)	Yes
34	Brodbeck (2001)	Yes
35	Hoegl and Gemuenden (2001)	Yes
36	J. J. Jiang, Klein, and Chen (2001)	
37	J. J. Jiang, Klein, and Shepherd (2001)	
38	Sawyer (2001)	Yes
39	Tiwana (2001)	
40	Yeh and Tsai (2001)	Yes
41	Aladwani (2002c)	Yes
42	Aladwani (2002a)	Yes
43	Gopal, Mukhopadhyay, and Krishnan (2002)	
44	Hong and Kim (2002)	Yes
45	Poppo and Zenger (2002)	Yes
46	Zowghi and Nurmuliani (2002)	Yes
47	Gopal et al. (2003)	
48	Herbsleb and Mockus (2003)	
49	Ho, Ang, and Straub (2003)	Yes
50	Hoegl et al. (2003)	Yes
51	Karlsen and Gottschalk (2003)	
52	MacCormack and Verganti (2003)	Yes
53	Nidumolu and Subramani (2003)	Yes
54	Ethiraj, Kale, Krishnan, and Singh (2004)	Yes
55	J. J. Jiang, Klein, Hwang, Huang, and Hung (2004)	
56	Jørgensen (2004)	
57	Karlsen and Gottschalk (2004)	
58	C. Koh, Ang, and Straub (2004)	Yes
59	N. L. Martin, Furumo, and Pearson (2004)	
60	Na, Li, Simpson, and Kim (2004)	

61	Tiwana (2004)	
62	Wallace et al. (2004a)	
63	Wallace, Keil, and Rai (2004g)	
64	Anderson and Dekker (2005)	Yes
65	Balaji and Ahuja (2005)	
66	Calisir and Gumussoy (2005)	
67	Ethiraj et al. (2005)	Yes
68	Gowan Jr and Mathieu (2005)	
69	K. J. Mayer and Nickerson (2005)	Yes
70	Ong, Tan, and Kankanhalli (2005)	
71	E. T. G. Wang, Chou, and Jiang (2005)	
72	E. T. G. Wang, Chen, Jiang, and Klein (2005)	Yes
73	Banker, Bardhan, and Asdemir (2006)	
74	Beck, Jiang, and Klein (2006)	Yes
75	Faraj and Sambamurthy (2006)	Yes
76	J. J. Jiang, Klein, and Chen (2006)	
77	G. Klein et al. (2006)	Yes
78	Mahaney and Lederer (2006)	Yes
79	V. L. Mitchell (2006)	
80	Mohamed, Hussin, and Hussein (2006)	
81	Patnayakuni et al. (2006)	Yes
82	Peslak (2006)	
83	D. Smith, Eastcroft, Mahmood, and Rode (2006)	
84	Tullio and Bahli (2006)	
85	E. T. G. Wang, Shih, Jiang, and Klein (2006)	Yes
86	Akgün et al. (2007)	Yes
87	Farh (2007)	Yes
88	Gemino et al. (2008)	
89	Goo and Nam (2007)	Yes

90	Grabski and Leech (2007)	
91	Han and Huang (2007)	
92	Henry, McCray, Purvis, and Roberts (2007)	Yes
93	J. J. Jiang, Klein, Beck, and Wang (2007)	Yes
94	Langer (2007)	Yes
95	C. Lee and Chen (2007)	Yes
96	Liang et al. (2007)	Yes
97	N. L. Martin, Pearson, and Furumo (2007)	
98	Moløkken-Østvold and Furulund (2007)	
99	Na, Simpson, Li, Singh, and Kim (2007)	
100	Narayanan (2007)	Yes
101	Parolia, Goodman, Li, and Jiang (2007)	Yes
102	Patnayakuni et al. (2007)	Yes
103	Ramasubbu and Balan (2007)	
104	Subramanian, Jiang, and Klein (2007)	Yes
105	Thompson, Smith, and Iacovou (2007)	
106	Tiwana and Keil (2007)	Yes
107	Verner, Evanco, and Cerpa (2007)	
108	Chow and Cao (2008)	
109	Gopal and Sivaramakrishnan (2008)	
110	Langer, Slaughter, and Mukhopadhyay (2008)	
111	J. Y.-C. Liu et al. (2008)	Yes
112	S. Liu et al. (2008)	
113	Mao et al. (2008)	Yes
114	Ramasubbu et al. (2008)	Yes
115	Thomas (2008)	Yes
116	Tiwana (2008a)	Yes
117	Tiwana (2008d)	Yes
118	E. T. G. Wang, Ju, Jiang, and Klein (2008)	Yes

119	C.-H. Wu, Wang, and Fang (2008)	
120	Beimborn et al. (2009)	Yes
121	Gelbard and Carmeli (2009)	Yes
122	Haney (2009)	Yes
123	Huckman et al. (2009)	Yes
124	Iacovou et al. (2009)	Yes
125	Janz and Prasarnphanich (2009)	
126	Jung and Goldenson (2009)	Yes
127	Keith, Demirkan, and Goul (2009)	Yes
128	J. Y.-C. Liu, Chen, Klein, and Jiang (2009)	Yes
129	Maruping et al. (2009)	Yes
130	Nagpal (2009)	Yes
131	Nan and Harter (2009)	Yes
132	Narayanaswamy (2009)	
133	Rai et al. (2009)	Yes
134	Staats (2009)	Yes
135	Susarla et al. (2009)	Yes
136	Tesch et al. (2009)	Yes
137	Tiwana (2009)	Yes
138	Y. Wang (2009)	
139	Alfaro (2010)	Yes
140	Basaglia, Caporarello, Magni, and Pennarola (2010)	Yes
141	Benlian (2010)	
142	Choi, Lee, and Yoo (2010)	Yes
143	Gopal and Gosain (2010)	Yes
144	Gopal and Koka (2010)	Yes
145	Gorla and Lin (2010)	
146	Hsu, Chen, Jiang, and Klein (2010)	Yes
147	Hsu, Lo, Lin, and Cheng (2010)	Yes

148	P. Krishnan (2010)	Yes
149	G. Lee and Xia (2010)	Yes
150	Leimeister, Yetton, Wüllenweber, and Krcmar (2010)	
151	Liberatore and Luo (2010)	Yes
152	J. Y.-C. Liu et al. (2010)	Yes
153	L. Liu and Yetton (2010)	
154	Mahaney and Lederer (2010)	Yes
155	Mani, Barua, and Whinston (2010)	
156	Mooi and Ghosh (2010)	Yes
157	Parolia, Jiang, Klein, Fernandez, and Li (2010)	Yes
158	Patnayakuni and Ruppel (2010)	
159	Pee et al. (2010)	Yes
160	Ramachandran and Gopal (2010)	Yes
161	Sawyer, Guinan, and Cooprider (2010)	Yes
162	Schlosser, Wagner, Beimborn, and Weitzel (2010)	Yes
163	Susarla et al. (2010)	Yes
164	Tiwana (2010)	Yes
165	Tiwana and Keil (2010)	Yes
166	Westner and Strahringer (2010)	
167	Wickramasinghe and Gunawardena (2010)	Yes
168	C.-H. Wu and Fang (2010)	Yes
169	Akgün, Keskin, Byrne, and Gunsel (2011)	Yes
170	C. C. Chen et al. (2011)	Yes
171	Y. Chen and Png (2011)	
172	Feng, Du, Ai, Zheng, and Abbott (2011)	
173	Gopal, Espinosa, Gosain, and Darcy (2011)	Yes
174	Hsu, Chang, et al. (2011)	Yes
175	Hsu, Liang, Wu, Klein, and Jiang (2011)	Yes
176	Huckman and Staats (2011)	Yes

177	Jun, Qiuzhen, and Qingguo (2011)	Yes
178	J. Y.-C. Liu, Chiang, Yang, and Klein (2011)	Yes
179	J. Y.-C. Liu, Chen, Chen, and Sheu (2011)	Yes
180	Y. Lu et al. (2011)	Yes
181	Mahaney and Lederer (2011)	
182	Narayanan, Balasubramanian, and Swaminathan (2011)	Yes
183	Parolia, Jiang, Klein, and Sheu (2011)	Yes
184	Ranganathan and Alfaro (2011)	Yes
185	Staats et al. (2011)	Yes
186	Thatcher, Cha, Ahuja, and Pingry (2011)	Yes
187	Tsai et al. (2011)	
188	E. T. G. Wang, Chang, Jiang, and Klein (2011)	Yes
189	Wiener, Remus, Mähring, and Gregory (2011)	Yes
190	Bapna et al. (2012)	
191	Chiu (2012)	Yes
192	Gopal and Koka (2012)	Yes
193	Günsel, Açikgšz, Tükel, and Öğüt (2012)	Yes
194	Heumann et al. (2012)	Yes
195	Hoermann et al. (2012)	Yes
196	Hsu, Lin, Cheng, and Linden (2012)	Yes
197	Hsu, Lin, Zheng, et al. (2012)	Yes
198	Hsu, Shih, Chiang, and Liu (2012)	Yes
199	Liang, Wu, Jiang, and Klein (2012)	Yes
200	Lin et al. (2012)	Yes
201	P. Lu, Song, and Song (2012)	Yes
202	Maheshwari, Kumar, and Kumar (2012)	Yes
203	Mani, Barua, and Whinston (2012)	
204	Muethel, Gehrlein, and Hoegl (2012)	Yes
205	Nagpal et al. (2012)	Yes

206	Narayanaswamy and Henry (2012)	Yes
207	Pankratz and Basten (2012)	
208	Rai, Keil, et al. (2012)	Yes
209	Slaughter, Harter, Ang, and Whitaker (2012)	Yes
210	Srivastava and Teo (2012)	Yes
211	Staats (2012)	Yes
212	Staats et al. (2012)	
213	Subramanyam, Ramasubbu, and Krishnan (2012)	Yes
214	Susarla (2012)	Yes
215	Tiwana (2012)	
216	C.-C. Wang and Farn (2012)	Yes
217	Wiener et al. (2012)	Yes
218	Bourdeau and Barki (2013)	Yes
219	da Silva et al. (2013)	Yes
220	Hoberg et al. (2013)	Yes
221	Hsu and Hung (2013)	Yes
222	Hsu, Hung, Chen, and Huang (2013)	Yes
223	Keil et al. (2013)	Yes
224	Lai and Hsu (2013)	
225	J. Lee, Lee, and Park (2013)	Yes
226	S. Liu (2013)	Yes
227	Mellis, Loebbecke, and Baskerville (2013)	Yes
228	Philippo, Heijstek, Kruiswijk, Chaudron, and Berry (2013)	
229	Ramasubbu et al. (2013)	Yes
230	Sakka et al. (2013)	Yes
231	Stankovic, Nikolic, Djordjevic, and Cao (2013)	
232	Xiang, Lub, and Gupta (2013)	Yes
233	Akgün et al. (2014)	Yes
234	Hsu, Chu, Lin, and Lo (2014)	Yes

235	Hung, Hsu, Su, and Huang (2014)	Yes
236	S. Liu and Wang (2014)	Yes
237	J.-G. Park and Lee (2014)	Yes
238	Reich, Gemino, and Sauer (2014)	Yes

Notes. MA: meta-analysis.

Table 33. Studies included in the analysis of S4

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