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Konrad Dongus
Technische Universität München, Chair for Information Systems, Munich, Germany, konrad.dongus@in.tum.de

Philip Yetton
University of New South Wales, Australian School of Business, Kensington, NSW, Australia, p.yetton@unsw.edu.au

Michael Schermann
Santa Clara University, michael.schermann@in.tum.de

Helmut Krcmar
Technische Universität München, Chair for Information Systems, Munich, Germany, krcmar@in.tum.de

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Complete Research

Dongus, Konrad, Technische Universität München, Chair for Information Systems, Munich, Germany, konrad.dongus@in.tum.de

Yetton, Philip, University of New South Wales, Australian School of Business, Kensington, NSW, Australia, p.yetton@unsw.edu.au

Schermann, Michael, Technische Universität München, Chair for Information Systems, Munich, Germany, michael.schermann@in.tum.de

Krcmar, Helmut, Technische Universität München, Chair for Information Systems, Munich, Germany, krcmar@in.tum.de

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 commoditisation, 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 behaviour rather than vendor behaviour.

Keywords: Transaction Cost Economics, IT outsourcing, Industry maturity, Meta-analysis, Contract type

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 (Gartner, 2013). Following Grover et al. (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 standardised and modularised, allowing ITO vendors to realise economies of scale (Manning, 2013). At the same time, the ITO industry has become increasingly consolidated and competitive (Manning et al., 2011). ITO clients are becoming more informed due to increased market

transparency contingent on the standardisation of ITO services and consolidation in the ITO market (Reimann et al., 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 et al., 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 and Zenger, 2002). Across this literature, Transaction Cost Economics (TCE), in which the transaction is the unit of analysis (Williamson, 1979; Williamson, 1985), is the dominant analytical framework (Dibbern et al., 2004; Karimi-Alaghehband et al., 2011; 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 commoditisation, 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 and Madon, 1997; Stadtmann and Kreutter, 2009; Suarez et al., 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 et al., 2013; Gefen et al., 2008; Gopal and Sivaramakrishnan, 2008; Gopal et al., 2003; Kalnins and 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.

2 Theoretical Background

TCE models the choice of contract type as a problem of minimising transaction costs (Bajari and Tadelis, 2001; Corts and Singh, 2004; Kalnins and Mayer, 2004). Assuming asymmetric information between the client and vendor, the choice is a trade-off between monitoring and renegotiation costs (Osei-Bryson and 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.

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 behaviour occurring decreases as client knowledge of project costs and project performance increases (Aron et al., 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 and Tadelis, 2001; Wathne and Heide, 2000).

The decision between FP and TM contracts mitigates the risk of opportunistic vendor behaviour (Bajari and Tadelis, 2001; Kalnins and Mayer, 2004; Osei-Bryson and 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 and Tadelis, 2001; Susarla et al., 2009).

In FP contracts, cost overruns negatively affect the project profitability for the vendor (Ethiraj et al., 2005; Gopal and Koka, 2012; Gopal and Sivaramakrishnan, 2008; Gopal et al., 2003). Thus, FP contracts provide strong incentives for vendors to manage projects in a cost-efficient way (Bajari and Tadelis, 2001; Corts and Singh, 2004; Kalnins and Mayer, 2004). For example, vendors assign more trained personnel to FP compared with TM projects (Arora and Asundi, 1999; Gopal and 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 and Ngwenyama, 2006; Susarla et al., 2009). Under TM contracts, therefore, clients must monitor vendor behaviour and performance closely to reduce information asymmetries and prevent vendors from shirking (Osei-Bryson and Ngwenyama, 2006; Susarla et al., 2009).

Renegotiation costs are higher under FP contracts compared with TM contracts (Bajari and Tadelis, 2001; Corts and Singh, 2004; Kalnins and 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 and 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 and Tadelis, 2001; Wathne and 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 and 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 and Tadelis, 2001; Fink et al., 2013; Gopal et al., 2003; Kalnins and 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 and 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 and 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.

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 and Madon, 1997; Manning et al., 2011; Stadtmann and Kreutter, 2009; Suarez et al., 2013). This development is partly a function of the increasing commoditisation of the ITO industry. Commoditisation has been achieved through service modularisation, service standardisation, 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 commoditised in 2007, increasing to over 50% in 2009, and reaching 71% in 2011/12 (Manning, 2013).

Commoditisation 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.

Commoditisation also stimulates cost-based competition, which increases the pressure for further market consolidation within the ITO industry (Manning et al., 2011). Both commoditised 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 commoditised 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 commoditised industries. Standardisation and modularisation 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.

3 Methodology

We investigated these hypotheses using meta-analysis, which is a suite of quantitative techniques to synthesise research findings across multiple studies (Glass, 1976; Hedges and Olkin, 1985; Hunter and Schmidt, 1990; Hunter and Schmidt, 2004). The input data are effect sizes, specifically correlation coefficients from individual studies addressing the same relationship of interest (Lipsey and Wilson, 2001). Utilising 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 et al., 1981; Hunter and Schmidt, 1990; Hunter and Schmidt, 2004; Rosenthal and 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 and King, 2008; Joseph et al., 2007; Sabherwal et al., 2006; Sharma and Yetton, 2003; Sharma and Yetton, 2007; Sharma et al., 2009; Wu and Lederer, 2009). Here, we describe the process of our meta-analysis under three headings: literature search, coding, and analysis.

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 and Yetton, 2003; Sharma and Yetton, 2007; Wu and Lederer, 2009), we conducted four complementary literature searches. This minimised the probability of failing to identify relevant studies. First, we conducted a systematic keyword search in the following databases[1]: 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[2]. Second, we conducted backward and forward searches (Webster and 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).

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[1] 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").

[2] 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).*

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[3].

The resultant meta-analysis sample includes 29 studies based on 23 independent samples[4] providing 94 effect sizes representing a total sample size of 6,343 ITO projects[5,6].

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 operationalise 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 operationalises 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, organisational complexity, and project size (Bajari and Tadelis, 2001; Crocker and Reynolds, 1993; Fink et al., 2013; Kalnins and Mayer, 2004). Accordingly, we coded all those variables as TEU. This involved judgment by the coders (Heugens and Lander, 2009). To minimise 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 and 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 and 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

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[3] 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.

[4] Multiple studies based on the same sample were included only where each of these studies reports at least one operationalisation of TEU that is not reported in the others. In this case, operationalisations 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.

[5] Represented in the references section by asterisks.

[6] 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).

early (emerging) and a later (mature) phase of an industry (see, e.g., Agarwal et al., 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).

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 analysed. Third, a robustness check is conducted to control our results for varying operationalisations 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 and 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 and Brannik, 2002; Hunter and Schmidt, 2004).

The correlation coefficients were corrected for measurement error (Hunter and 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; 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 ($CI_{\bar{\rho};.95}$)[7]. 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 generalisability 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 artefacts ($\%V$), and Cochran's (1954) chi-square statistic for heterogeneity (Q). We assessed generalisability 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 generalisability of the expected rho (Hunter and Schmidt, 2004). When the credibility interval is large or includes zero, the expected rho does not generalise (Whitener, 1990).

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

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 artefacts, Hunter and Schmidt (2004) suggest a relationship to be heterogeneous. When Cochran's (1954) chi-square statistic is significant, the expected rho does not generalise. Instead, it should be interpreted as the expected value of a number of effects rather than a common true effect (Hedges and Olkin, 1985).

Moderating Effect

We use an ANOVA-based subgroup-analysis procedure (Borenstein et al., 2009) to analyse 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).[8] 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., Park and Shaw, 2013). In the analysis reported here, a relationship with a significant $Q_{between}$-statistic is interpreted as showing that 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 operationalisations of TCE's core variables might cause mixed TCE results in ITO research (David and Han, 2004; Karimi-Alaghehband et al., 2011). Specifically, research highlighted the mixed results with varying operationalisations of uncertainty (Carter and Hodgsen, 2006). To control for variations between different operationalisations of TEU, we additionally conducted the meta-analytic calculations for each operationalisation of TEU separately. In this analysis, the 94 initial effect sizes were combined into 64 independent effect sizes.

4   Results

The results in Table 1 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 generalisability of the relationships ($CR_{\bar{\rho};.80}$, $\%V$, Q), Table 1 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*

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 1.   TEU and Contract Type

Table 2 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 ($\bar{\rho} = .14$)

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[8] 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.

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).

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*

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 2.   TEU and Contract Type: Controlling for Industry Maturity

Table 3 presents the meta-analytic results for the relationships between TEU and choice of contract type, controlling for both industry maturity and different operationalisations of TEU. In the emerging industry phase, estimating the relationship between TEU and choice of contract type, requirements uncertainty has the largest significant effect ($\bar{\rho} = .23$), organisational complexity the lowest significant effect ($\bar{\rho} = .12$), and technological complexity the lowest non-significant effect ($\bar{\rho} = .05$). So, contingent on the operationalisation 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 operationalised.

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
Organisational 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
Organisational complexity	8	2,803	−.06	.17	−.18 :	.07
Project size	8	2,462	.10	.21	−.06 :	.25

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 3.   Effect Sizes for Different Measures of TEU

5   Discussion

The results in Table 1 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 2 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 operationalisations of TEU, the results in Table 3 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, organisational complexity, and project size (see the 95% confidence intervals in Table 3). In the mature phase, the relationship between TUE and choice of contract type is non-significant for all the measures of TEU (See Table 3).

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 and 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 Tables 1, 2 and 3.

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 operationalisations 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 artefacts 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 artefacts including range restriction and dichotomisation of continuous variables. However, information that must be extracted from the individual studies to correct for these artefacts 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.

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 1 report a small significant effect of TEU on choice of contract type, Table

1 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 1 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 4). 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 generalise 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%)

k: number of effect sizes.

Table 4.   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 rigour, such as varying construct operationalisations, may have caused the mixed TCE-support in empirical ITO research. The results of our robustness check indicate that methodological rigour 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 operationalisations of TEU (See Table 3). However, in the mature ITO industry phase, Table 3 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 2 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 2, 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 commoditisation, 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 and Bigelow, 2007; Karniouchina et al., 2013; Misangyi et al., 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 generalise 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 internalised 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 recognise 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 et al. (2013), we propose that the new analytical framework should focus on client behaviour as the critical aspect. Variance in client behaviour to manage the client-vendor relationship is likely to be much larger than differences in vendor behaviour. Vendors have many more opportunities to learn by doing than do clients. This would fundamentally reframe the theory of ITO to be client behaviour-centric and not based on a model of a market in which major service organisations are assumed to defect on their contracts with their clients.

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 and Bigelow, 2007) and recent market developments in the ITO industry, including increasing commoditisation, 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 behaviour rather than on vendor behaviour. 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 and Bigelow, 2007).

This study extends the general maturity-based literature to research on governance decisions in buyer-supplier relationships in the global ITO industry.

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