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Fostering incremental and radical innovation through performance-based contracting in buyer-supplier relationships

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Abstract

Purpose – While anecdotal evidence suggests that performance-based contracts (PBCs) may foster innovation in buyer-supplier relationships, the understanding of the underlying mechanisms is limited to date. The purpose of this paper is to draw on transaction cost economics and agency theory to develop a theoretical model that explains how PBCs may lead to innovation.

Design/methodology/approach – Using data on 106 inter-organizational relationships from the Dutch maintenance industry, the authors investigate how the two main features of PBCs – low-term specificity and performance-based rewards – affect incremental and radical innovation.

Findings – The authors find that term specificity has an inverse-*U*-shaped effect on incremental innovation and a non-significant negative effect on radical innovation. Furthermore, pay-for-performance has a stronger positive effect on radical innovation than on incremental innovation. The findings suggest that in pursuit of incremental innovation, organizations should draft contracts with low, but not too low, term specificity and incorporate performance-based rewards. Radical innovation may be achieved by rewarding suppliers for their performance only.

Originality/value – The findings suggest that in pursuit of incremental innovation, organizations should draft contracts with low, but not too low, term specificity and incorporate performance-based rewards. Radical innovation requires rewarding suppliers for their performance only.

Keywords Innovation, Outsourcing, Operations improvement, Maintenance management, Collaboration, Process improvement

Paper type Research paper

1. Introduction

Radical and incremental innovation in products and services is critical for firms' sustained competitive advantage and long-term survival (Camisón and López, 2010; Faems *et al.*, 2005; Johnston and Leenders, 1990). Increasingly, firms complement their internal innovation capabilities with solutions, ideas, and technologies from external partners such as suppliers (Chesbrough *et al.*, 2008). Suppliers are believed to enhance or even drive innovation (Faems *et al.*, 2005) in products and services, as well as in service outsourcing contexts in which suppliers innovate to improve and optimize the daily operations performed for the buyer.

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Buyer-supplier relationships may, however, suffer from opportunistic behavior or coordination failures that impede the efforts of even well-intentioned parties (Malhotra and Lumineau, 2011; Williamson, 1985), and inhibit innovation. Organizations therefore draw on two types of governance mechanisms: formal governance such as contracts and relational governance such as trust. While the latter has extensively been related to performance effects, research on how contracts affect performance, particularly innovation, remains limited (Schepker *et al.*, 2014). The pertinent literature is largely inconclusive: while some studies suggested that contracts positively affect innovation (Johnson and Medcof, 2007; Wang *et al.*, 2011), others did not find any such effect (Gopal and Koka, 2010).

We therefore study the effects of contracts on innovation. Our specific focus is on performance-based contracts (PBCs), which specify the outcome of a transaction rather than how the transaction is to be performed or with what resources (Kim *et al.*, 2007; Randall *et al.*, 2010) and which have been conjectured, but not demonstrated, to drive innovation (Kim *et al.*, 2007; Martin, 2002; Ng and Nudurupati, 2010). However, this claim lacks empirical validation. To understand how PBCs affect innovation, we analyze two typical features of PBCs: low-term specificity and performance-based rewards. The first refers to the extent to which contractual clauses related to obligations and behaviors are specified in detail (Furlotti, 2007; Luo, 2002). The second refers to the extent to which the supplier's payment is linked to the degree to which outcomes are achieved, i.e., the incentives structures incorporated in the contract (Argyres and Mayer, 2007; Martin, 2002). Using transaction cost economics (TCE) and agency theory (AT), we hypothesize how these two features affect incremental and radical innovation, and test these hypotheses using survey data on 106 IORs from the Dutch maintenance industry. Whereas radical innovation is defined as developing new service offerings or making a fundamental change to existing service offerings, incremental innovation involves minor improvements or adjustments in existing service offerings or making small process changes (Das and Joshi, 2007; Dewar and Dutton, 1986). We distinguish between incremental and radical innovation because it has been suggested that organizational antecedents favorable for one type of innovation may be unfavorable for the other (de Brentani, 2001; Koberg *et al.*, 2003). Yet, empirical studies provide mixed results (Jansen *et al.*, 2006).

Our study makes several theoretical contributions. First, focusing on innovation as a performance outcome (Anderson and Dekker, 2005), and in particular the distinction between incremental and radical innovation, constitutes an important contribution to the innovation literature. Second, relating PBCs to a positive relationship outcome adds to the scarce research on the performance implications of contracts (Anderson and Dekker, 2005; Schepker *et al.*, 2014; Vandaele *et al.*, 2007) and to the limited number of studies on the use and effects of PBCs (Hypko *et al.*, 2010; Martin, 2002). Finally, whereas previous research has drawn on either TCE or AT to understand the effects of governance on outcomes (Anderson and Dekker, 2005; Johnson and Medcof, 2007; Wang *et al.*, 2011), our empirical study uses them collectively to understand the performance implications of contracts. Managerial relevance stems from the fact that PBCs are increasingly being adopted in practice (Hypko *et al.*, 2010; Martin, 2002), but with varying degrees of success. An enhanced understanding of the effects of PBCs on innovation may contribute to effective contracting behavior.

The remainder of this paper is as follows. First, we draw on the literature on (performance-based) contracting to define the features of PBCs and argue how they affect

incremental and radical innovation. Then, we describe our research methodology, analyses, and results. Finally, we present our conclusions and discussion, deliberate some important limitations, and offer suggestions for future research.

2. Background and model development

2.1 PBCs and innovation

PBCs are used for the effective and cost-efficient (out)sourcing of business services (Datta and Roy, 2011). While traditional contracts, such as fixed-price or cost-plus contracts, focus on inputs and processes, PBCs reward suppliers based on the extent to which outputs and outcomes (i.e. contracted performance) are achieved (Kim *et al.*, 2007). For example, in a PBC, a supplier maintaining an airplane's turbine engine is not reimbursed for the materials used (e.g. spare parts) or the activities conducted, but rewarded for the uptime of the engine (i.e. also known as Rolls-Royce's "power by the hour") (Kim *et al.*, 2007; Ng *et al.*, 2009). The supplier decides how to attain the targeted performance, and hence has the autonomy to engage in new and improved ways of delivering the service. Such performance-based incentive structures are emerging in both the manufacturing and service industries and in both the private and public sectors (Hypko *et al.*, 2010).

Relative to the level of managerial attention, scholarly attention for PBCs remains limited. Existing studies cover a variety of sectors and bring forward highly contextual findings (Hypko *et al.*, 2010; Kleemann and Essig, 2013; Martin, 2002) and often lack a sound theoretical basis (Selviaridis and Wynstra, 2015). These sector-specific definitions do share two underlying concepts (Martin, 2002). First, PBCs do not specify all observable obligations and actions (i.e. processes and inputs), only desired performances, results, or outcomes. This closely resembles low-term specificity: the extent to which processes and behaviors are specified in the contract (Luo, 2002), or, the extent to which the supplier has freedom in designing, managing, and executing the service processes. Hence, term specificity does not entail the extent to which outcomes are specified as PBCs may contain detailed descriptions of outcome indicators and how they should be measured. Second, PBCs reward suppliers based on the extent to which contracted performance is actually achieved (Martin, 2002). Thus, in general, PBCs can be characterized in terms of low-term specificity and supplier's rewards being linked to performance (de Vries *et al.*, 2014; Hypko *et al.*, 2010; Ng and Nudurupati, 2010).

We build on contracting literature to define innovation as all supplier-initiated, proactive undertakings that result in new (i.e. radical) or improved (i.e. incremental) ways of delivering services (Johnson and Medcof, 2007). In the service outsourcing context, these innovations take place in the (in)tangible aspects of the service system (Gallouj and Weinstein, 1997). A key premise is that the buyer taps into the supplier's entrepreneurial knowledge and ideas (Shimizu, 2012). Both parties may benefit from the innovation (e.g. better service for the buyer and/or more efficient service delivery for the supplier), which takes place within the context of a specific buyer-supplier relationship, specifically in the activities that a supplier conducts for and in collaboration with a specific buyer[1]. As part of their daily activities, suppliers may incrementally improve or more radically change the daily service delivery toward the buyer, with the aim of more efficiently and/or effectively achieving performance targets such as quality and delivery time. While this will mostly include (incremental) process innovations, suppliers may also make more radical changes, for example, to the tangible aspects of the transaction (such as a new technology), which may result in substantially greater customer benefits relative to existing products and services (Chandy and Tellis, 1998).

2.2 Theoretical basis and hypothesis development

PBCs focus on outcomes, and are therefore less precise regarding processes, behaviors, and inputs. Consequently, PBCs are relatively more incomplete than traditional contract types that prescribe required or expected activities and behaviors in great detail. The prescribing nature of more complete contracts inhibits innovation (Hart, 1989; Wang *et al.*, 2011). In contrast, the open nature of incomplete contracts is expected to foster innovation, as it enhances the supplier's freedom to organize the processes underlying the transactions in the way they consider best (i.e. low degrees of term specificity) (Bernheim and Whinston, 1998; Luo, 2002).

Open or incomplete contracts, however, do not sufficiently address the transaction characteristics that may result in opportunistic behavior (Williamson, 1985). This opportunistic behavior should be mitigated, and mainstream literature proposes two solutions for this that stem from two theories that have been used extensively in studies on contract design and implications for performance (Argyres and Mayer, 2007; Eisenhardt, 1989; Luo, 2002; Williamson, 1985): TCE and AT.

From a TCE perspective, the risk of opportunistic behavior should be mitigated by a more complete contract. This solution may, however, jeopardize innovation, as more contractual detail restricts the supplier's decision-making freedom regarding how to best attain the desired level of performance. Alternatively, AT suggests that the problem of opportunistic behavior may be solved by implementing incentive structures which link the supplier's rewards to its performance (Eisenhardt, 1989). Suppliers will try to maximize their rewards and will innovate to meet or exceed performance targets more quickly and/or more frequently.

The two theories thus provide different solutions for curbing opportunism, with differing consequences for innovation. Hence, we need to consider TCE and AT collectively rather than separately to understand the effects of contracts on innovation.

2.2.1 Effect of term specificity on incremental and radical innovation. Term specificity has been considered in both TCE and AT studies on contracting and innovation. From a TCE perspective, Wang *et al.* (2011) argue that very detailed contracts may hamper existing knowledge exchange and innovation because of the clear contractual specification of what is and is not allowed. Similarly, from an AT perspective, Johnson and Medcof (2007) argue that specifying only the desired outcomes allows the supplier room for innovation. Higher autonomy enables the supplier to approach problems and performance metrics in a way that makes the most of its expertise and creative thinking (Amabile, 1998; Liao *et al.*, 2010; Woodman *et al.*, 1993). Thus, both perspectives suggest a relationship between term specificity and innovation, i.e., relatively low levels of term specificity foster innovation.

With regard to incremental innovation, low-term specificity gives the supplier the autonomy to exploit existing knowledge. The supplier will pursue profit maximization by leveraging existing strengths and identifying new opportunities within existing knowledge domains. However, there is a caveat: incremental innovation also requires a certain foundation, which clarifies the principles related to achieving the desired performance output (e.g. information about existing knowledge and processes). In other words, a certain degree of term specificity is still required as a frame of reference that limits the supplier in deviating from the existing way of conducting business, while still enabling the supplier to improve processes and outputs (Jansen *et al.*, 2006). For example, a certain degree of term specificity facilitates the generation of ideas to improve existing ways of conducting business by using known knowledge domains.

Wang *et al.* (2011) indeed find that insufficient contractual detail negatively affects innovation. Hence, we argue that neither a too low nor a too high degree of term specificity is beneficial for incremental innovation:

H1a. There is an inverted-*U*-shaped relationship between term specificity and incremental innovation.

With regard to radical innovation, low levels of term specificity should not stall the output of innovations. Low-term specificity enables the supplier to exchange and generate new knowledge (Wang *et al.*, 2011). Radical innovation draws on new knowledge, the development of which is promoted by high autonomy (Lumpkin and Dess, 1996; Nonaka *et al.*, 2000). Low-term specificity hence grants the supplier the autonomy to engage in and support new ideas, demonstrate creative experimentation, and take actions free of contractual constraints. As autonomy fosters creativity and provides a basis for exploratory learning, both buyer and supplier should have sufficient autonomy to exchange new knowledge that may lead to radical innovation (Popadiuk and Choo, 2006). Conversely, reliance on contractual rules and procedures hampers experimentation and ad hoc problem-solving efforts and reduces the likelihood that the supplier deviates from established behaviors (Jansen *et al.*, 2006). Accordingly, higher degrees of term specificity constrain radical innovation:

H1b. There is a negative relationship between term specificity and radical innovation.

2.2.2 Effect of pay-for-performance on incremental and radical innovation. The second characteristic of PBCs stems from AT and relates to incentive structures, i.e., the supplier's rewards that are, at least partly, linked to its performance. Performance-based remuneration is an incentive structure that aligns the interests of buyers and suppliers and reduces the potential for opportunistic behavior created by incomplete contracts[2] (Devers *et al.*, 2007; Eisenhardt, 1989; Makri *et al.*, 2006). Contracts with performance-based incentives reward the supplier for the delivery of outcomes that are closely related to its efforts (Argyres and Mayer, 2007; Lyons, 1996). In contrast, if rewards are linked to behaviors or resources used; the supplier will refrain from activities that are not rewarded, such as innovation (Deckop *et al.*, 1999). In the most extreme case, any new initiative (incremental or radical) would be a breach of contract (Johnson and Medcof, 2007).

In contrast, pay-for-performance induces the supplier to behave in the interest of the buyer and to engage in activities that improve performance, as the increased net profits will (partly) accrue to the supplier. Indeed, financial incentives affect both incremental and radical innovation positively (Abbey and Dickson, 1983; Johnson and Medcof, 2007; Shepherd and DeTienne, 2005). Anticipating that incentive payments will offset investments (Heinrich and Choi, 2007), the supplier is inclined to invest in innovative activities that, for example, result in lower costs or increased quality while maintaining performance (Randall *et al.*, 2010). These arguments lead us to posit:

H2a. There is a positive relationship between paying the supplier based on its performance and incremental innovation.

H2b. There is a positive relationship between paying the supplier based on its performance and radical innovation.

It should be noted though that radical innovation is inherently more risky as it involves relatively higher uncertainty, complexity, and unpredictability (Cabrales *et al.*, 2008), and is associated with higher variability in outcomes and a higher probability of

failure. For these reasons, radical innovation is generally associated with higher net profits so as to compensate for the higher risks involved (Bloom and Milkovich, 1998; Sanders and Hambrick, 2007). On that account, we expect the positive effect of performance-based pay to be stronger for radical than for incremental innovation:

H2c. The positive effect of pay-for-performance is stronger for radical than for incremental innovation.

3. Methods

3.1 Survey instrument and measures

We used existing literature to develop our questionnaire aimed at measuring our key and control variables. We pre-tested the questionnaire with eight practitioners and management researchers in order to verify appropriateness of wording and to identify ambiguities in the terms and concepts or other issues. We made minor changes to the wording based on the feedback received. In addition, we conducted a small pilot study: in collaboration with the Dutch Association for Purchasing Management (NEVI), we surveyed 74 purchasing managers from various industries. We used the responses to evaluate the feasibility, the time taken, and any adverse events so that we could improve the study design prior to actual data collection, and to evaluate and validate our measurement items.

We operationalized the variables using single- or multi-item reflective measures based on scales used in previous research. As we collected the data from the Dutch maintenance industry, the survey questions were adapted so that they fit the context of maintenance service transactions. The items were measured using either five- or seven-point Likert-type rating scales (strongly disagree-strongly agree) (see Table AI).

3.1.1 Radical and incremental innovation. Incremental innovation was measured with a seven-item scale (five-point Likert-type) focusing on the extent to which the supplier engaged in minor changes to existing services such as improving the efficiency of the maintenance process. The measurement items are based on Jansen *et al.* (2006).

Radical innovation was measured using a four-item scale (five-point Likert-type). The items for this construct are based on Gallouj and Weinstein (1997) and Den Hertog (2000) and focus on the extent to which the maintenance provider has developed a new service and/or a new technology.

3.1.2 Term specificity. Term specificity is the extent to which the contractual clauses prescribe how the supplier should deliver the service or which resources it should use. Based on Argyres *et al.* (2007), Mayer (2006), and Ryall and Sampson (2009), we measured term specificity in a three-item scale (seven-point Likert-type) capturing to what extent the contract prescribes how the supplier should develop certain technologies and which specific resources should be contributed to the service delivery.

3.1.3 Pay-for-performance. Pay for performance was measured on a six-item scale (seven-point Likert-type) based on items from Jaworski *et al.* (1993). The items capture the extent to which the supplier's rewards are linked to its performance (i.e. the outcome of the service) and the extent to which the supplier has sufficient financial incentives to improve the service.

3.1.4 Control variables. Control variables were used in order to eliminate undesirable sources of variance in the hypothesis testing procedure. Firm size, measured as the number of employees, can influence both types of innovation because organizations of different sizes exhibit different organizational characteristics and resource deployment (Wang *et al.*, 2011). For example, large firms may have slack resources that may positively affect innovation.

Second, we controlled for relationship length, measured as the number of years since the relationship formation, because enduring relationships may help parties build trust (Malhotra and Lumineau, 2011), which may, in turn, affect innovation (Wang *et al.*, 2011).

Third, trust is viewed as an important mechanism to stimulate innovation (Nielsen and Nielsen, 2009). The interaction between parties that trust each other will be more informal, leading to the creation and sharing of existing and/or new knowledge that may result in innovation. We measured trust using a validated nine-item scale (Lui and Ngo, 2004) that captures contractual, goodwill, and competence trust. Contractual trust is the extent to which both parties are true to the contract. Competence trust focuses on whether the parties are able to fulfill an agreed-upon obligation. Goodwill trust refers to the trust one has in the partner's intention to fulfill its role in the collaboration (Das and Teng, 2001; Lui and Ngo, 2004).

Fourth, since attitudes toward risk differ among organizations, and influences innovation (March and Shapira, 1987), we control for the supplier's degree of risk-aversion. Supplier risk-aversion was measured using a single-item, seven-point Likert scale, investigating to what extent the supplier prefers the "tried and true" paths (Venkatraman, 1989). Even though single-item risk-preference measures work well in existing research (Dohmen *et al.*, 2011; Pennings and Garcia, 2001), using a single item poses risks to capturing the actual construct. Nevertheless, we opted for a single-item measure because, high-quality, validated reflective measures of organizational risk-aversion in an IOR context are virtually nonexistent since it has received little attention in research. Furthermore, the measures developed by Venkatraman (1989) demonstrated weak measurement model results when multiple items were used in our pilot study.

Finally, we controlled for transactional complexity and industry effects, as prior research has shown that the industry in which the firm operates and the complexity of the transaction may affect incremental and radical innovation (Damanpour, 1991; de Brentani, 2001). Transactional complexity was evaluated by asking respondents about the complexity of the service offering in the selected contract. For industry effects, we created dummy variables for the six maintenance sectors.

We pooled the buyer and supplier data because there are no theoretical arguments suggesting differentiated governance effects on either side of the buyer-supplier relationship (Jap and Anderson, 2003). Still, for the sake of prudence, we opted to control for perception differences between buyers and suppliers via a binary dummy variable for the type of organization the respondent represents (i.e. asset owner or maintenance provider).

3.2 Sample selection and data collection

We selected buyer-supplier relationships as our unit of analysis, as such relationships strongly rely on contractual governance. Data collection took place in the maintenance sector for two reasons: first, because of the increasing importance and use of PBCs in this sector (Hypko *et al.*, 2010); and second, because suppliers rely strongly on innovation to attain the continuous performance improvements that outsourcers of maintenance services expect from them. Innovation in this sector may concern minor changes that lead to a more efficient maintenance process (e.g. a performance dashboard that diagnoses specific problems in advance of the supplier's site visit) or more major changes that increase the effectiveness of the maintenance process (e.g. changing certain spare parts to reduce the overall maintenance activities).

We collected our data in 2013 from the members of the Dutch Association for Maintenance Services (in Dutch: Nederlandse Vereniging voor Doelmatig Onderhoud (NVDO)), using a self-administered online survey. The 1,227 member organizations are asset owners (i.e. buyers of maintenance services) (430), providers of maintenance services (430), or consultants (367), operating in one of six different maintenance sectors (real estate, infrastructure, fleet (excluding passenger cars), process industry, manufacturing, and food, beverage, and pharmaceuticals).

We contacted the board members of NVDO to obtain their approval and support, and subsequently presented the research toward members as a joint effort, with the goal of maximizing the response rate. All members received the questionnaire and an enclosed introductory letter explaining the intent of the study, assuring confidentiality, and indicating the preferred survey respondent (i.e. a manager knowledgeable about the content of the contract and the collaboration). The respondents were asked to indicate whether they were an asset owner, a maintenance provider, or a consultant, and to complete the questionnaire based on a recent contract they are extensively involved in (note that consultant responses were excluded from the analysis). Given our focus on the use of formal governance in buyer-supplier relationships, our eventual data set only includes responses obtained from the 860 asset owners and maintenance service providers.

After three reminders, we used telephone calls to further boost the response rate. Eventually, 169 questionnaires were received, for an overall response rate of 19.7 percent (169/860). In total, 63 responses were discarded due to excessive missing values, resulting in a final usable data set of 106 responses (i.e. effective response rate of 12.3 percent) of which 11.9 percent (51/430) are asset owners and 12.8 percent (55/430) are maintenance providers (note that these are not matched pairs). On average, the respondents have 14 years of experience (SD = 8.4) in managing relationships with external suppliers, and have managed 18 contracts (SD = 17) in 2012. These figures suggest that the informants have a high level of competence, which indicates that the responses should be of sufficient quality. Table I shows information about the respondents.

To assess the potential risk of respondent bias, we conducted a wave analysis (Armstrong and Overton, 1977). The final sample includes 32.1 percent of the responses

Information	%/number
Number of employees	59% of the responding firms have more than 250 employees
Average revenue	1,273 million (SD: 4,567)
Maintenance industries	
Process industry	39.6%
Real-estate	19.8%
Food, beverage and pharmaceuticals	13.2%
Infrastructure	11.3%
Manufacturing	8.5%
Fleet	5.7%
Roles of the respondents	
Contract manager	13.2%
Director/owners	13.2%
Advisor	12.3%
General manager	12.3%
Maintenance manager	6.6%
Operations/production manager	6.6%

Table I. Information about the respondents

in the first wave and 67.9 percent in the second wave after the first reminder. We compared the sector in which the respondent is active, the function of the respondent, the number of employees, and the number of contracts the respondent managed in 2012. We also compared the responses to all our independent and dependent variables. The results of the independent-sample *t*-tests showed no significant differences between these groups (p-values $\geqslant 0.05$). In addition, the descriptive characteristics were investigated for a group of respondents (56.5 percent) that only provided very few answers, assuming that these could be representative of non-respondents. We found no significant differences between this group of respondents and the respondents in our data set, suggesting that non-response bias is not a serious threat. The main reason for not completing the survey – as indicated by non-respondents during the callback sessions – was lack of time. This also suggests that there are no differences between respondents and non-respondents.

4. Results

To estimate the measurement and structural models, we opted for partial least squares (PLS), which has been widely adopted in business research (e.g. Bala and Venkatesh, 2015; Calvo-Mora *et al.*, 2014; Kortmann *et al.*, 2014; Lioukas and Reuer, 2015), for two reasons. First, compared to covariance-based structural equation modeling (CBSEM), PLS is a more appropriate tool for analyzing hypotheses at an early stage of model development (Peng and Lai, 2012), as is the case with our model on contractual characteristics and innovation. Second, the inverse-*U* in combination with two dependent variables and the sample size makes our model complex. For complex models, CBSEM increases the total number of parameter estimates, possibly leading to model identification and convergence issues (Peng and Lai, 2012). Model complexity may even increase the required sample size in CBSEM since an inverse-*U* effect involves the computation of a new construct by quadrating the items of existing constructs. PLS, on the other hand, uses an iterative algorithm to separately calculate parts of the measurement model, and it subsequently estimates the structural path coefficients (Peng and Lai, 2012). This leads to a successful estimate of the factor loadings and structural paths for each individual subset (Peng and Lai, 2012). PLS thus readily accommodates complex relationships in the structural model and it does so effectively with a relatively small sample size (Hair *et al.*, 2009).

Prior to measure assessment, the expectation-maximization algorithm was applied to impute the small amount of missing values. We then used a bootstrapping sample of 5,000 and ran 300 cases per resampling step to estimate the standard errors and statistical significance of the structural paths. A large bootstrapping sample (500 or more) is recommended because it reduces the effect of random sampling error (Hair *et al.*, 2011; Peng and Lai, 2012). As a recommended standard practice (Ahuja *et al.*, 2003), we replicated the analyses with three additional iterations (bootstrapping samples of 200, 500, and 1,000) to assess the stability of the significance of the path coefficients. The results are consistent across the bootstrap samples.

4.1 Measurement model

Unidimensionality, convergent validity, and discriminant validity of our multi-item constructs were assessed with confirmatory factor analysis. In line with previous research, we followed Gefen and Straub (2005) and validated our measures by using standard factorial validity for PLS (Im and Rai, 2008).

Table II presents the descriptive statistics and bivariate correlations among the variables. The variance inflation factors (VIFs) of all variables (maximum VIF: 1.85) are well below the common rule-of-thumb cut-off of 10 (Hair *et al.*, 2009). This suggests that multicollinearity is not a major concern. All indicators load high (> 0.65) on their respective constructs and are significant at a 1 percent significance level, providing evidence for unidimensionality and convergent validity. The composite reliabilities exceed the 0.70 threshold for acceptable reliability (Bagozzi and Yi, 1988) and coefficient α values range between 0.68 and 0.93. All average variance extracted (AVE) values exceed the 0.50 threshold and each construct extracts variance that is larger than the highest variance it shares with other constructs (squared correlations) (Fornell and Larcker, 1981). This and the fact that our data does not contain cross-loadings, provide evidence of discriminant validity among the theoretical constructs (Hair *et al.*, 2009).

To minimize the possibility of common-method bias, we took several preventive measures (Podsakoff *et al.*, 2003). First, our pre-test helped to minimize item ambiguity and comprehension problems. Second, guaranteeing respondent anonymity reduces the risk of social desirability bias. Finally, we included reverse-coded items and used different scale formats to reduce the potential effects of pattern responses. To determine the effectiveness of our measures, we performed Harman's post hoc one-factor test, which indicated that the first factor accounts for only 26.91 percent of the variance. As such, the observed variance cannot be explained by one underlying factor (Im and Rai, 2008). Collectively, these results indicate that common-method bias is unlikely to be a major threat to the validity of our analyses.

4.2 Hypothesis tests

To test the developed hypotheses, we specified two models, each simultaneously measuring the effects of the independent variables on both dependent variables. Model 1 captures only the control variables, while Model 2 evaluates the impact of the direct effects of the independent variables (including the cross-product variable of term specificity) on the dependent variables. Term specificity was mean-centered prior to creating the quadratic term. The results are shown in Table III.

Variable	1	2	3	4	5	6	7	8	9
1. Radical innovation	1								
2. Incremental innovation	0.50**	1							
3. Term specificity	0.24*	0.49**	1						
4. Pay-for-performance	0.37**	0.19	0.35**	1					
5. Supplier risk-aversion	–0.10	–0.18	–0.02	0.06	1				
6. Transactional complexity	0.15	0.21*	0.25**	0.21*	–0.02	1			
7. Trust	0.15	0.32*	0.32**	0.01	0.03	0.20*	1		
8. Relationship length	–0.03	0.11	–0.01	–0.02	0.07	0.06	0.15	1	
9. Firm size	–0.06	–0.20*	–0.12	0.08	0.03	0.06	–0.18	–0.07	1
Mean (*M*)	3.12	3.38	3.43	3.67	4.97	3.5	3.93	11.49	5.91
SD	0.92	0.88	1.53	1.45	1.25	0.89	0.64	8.43	2.39
Coefficient α	0.85	0.93	0.68	0.87	–	–	0.90	–	–
Composite reliability	0.90	0.94	0.82	0.90	–	–	0.92	–	–
Average variance extracted (AVE)	0.69	0.70	0.61	0.60	–	–	0.56	–	–

Notes: $n = 106$ (buyers = 51, suppliers = 55). Pearson product-moment correlation coefficients are shown. *$p < 0.05$; **$p < 0.01$ (two-tailed)

Table II.
Descriptive statistics and correlation matrix

	Model 1: controls only		Model 2: direct effects	
	Incremental innovation	Radical innovation	Incremental innovation	Radical innovation
Control variables				
Firm size	–0.13 (0.04)**	–0.03 (0.04)	–0.14 (0.04)**	–0.05 (0.04)
Relationship length	0.01 (0.02)	–0.09 (0.05)****	0.05 (0.03)	–0.07 (0.05)
Trust	0.23 (0.04)**	0.12 (0.06)****	0.19 (0.04)***	0.13 (0.05)*
Supplier risk-aversion	–0.13 (0.05)**	–0.06 (0.05)	–0.13 (0.04)**	–0.08 (0.05)****
Transactional complexity	0.15 (0.05)**	0.13 (0.06)*	0.08 (0.04)****	0.04 (0.04)
Industry: infrastructure	0.19 (0.05)	0.01 (0.04)	0.11 (0.05)*	0.04 (0.04)
Industry: fleet	0.03 (0.03)	0.06 (0.04)	–0.01 (0.02)	–0.01 (0.03)
Industry: process	0.08 (0.05)	0.04 (0.05)	0.06 (0.04)	0.01 (0.05)
Industry: manufacturing	–0.06 (0.05)	–0.05 (0.05)	–0.07 (0.05)	–0.09 (0.06)
Industry: food, beverage, pharma	–0.19 (0.06)**	–0.13 (0.07)*	–0.14 (0.05)**	–0.13 (0.06)****
Perspective focal firm/partner	0.43 (0.05)***	0.23 (0.05)***	0.36 (0.05)***	0.24 (0.05)***
Direct effect variables				
Term specificity			0.23 (0.06)***	–0.05 (0.05)
Term specificity^2			–0.10 (0.05)*	
Pay-for-performance			0.11 (0.05)*	0.41 (0.05)***
R^2	0.46	0.15	0.54	0.28
ΔR^2			0.08	0.13

Notes: Standardized coefficients are shown, with standard errors in parentheses. Models were estimated using SmartPLS; dummy variable industry: "real-estate sector" served as baseline category; dummy variable perspective: "focal firm" served as baseline category. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$; ****$p < 0.10$ (two-tailed)

Table III.
Results of PLS analysis

Model 2 explains a relatively large amount of variance in incremental innovation ($R^2 = 0.54$) and in radical innovation ($R^2 = 0.28$), which compares favorably with other studies investigating innovation in IOR settings (Im and Rai, 2008; Lui and Ngo, 2004; Luo, 2002). We also evaluated how well the estimated model reconstructs our empirical data (i.e. predictive relevance) using the Stone-Geisser's Q^2 criterion and the blindfolding technique. For the final model, Q^2 is greater than zero for incremental and radical innovation, indicating acceptable predictive relevance (Peng and Lai, 2012).

H1a states that the relationship between term specificity and incremental innovation is inversely *U*-shaped. The results show a positive and significant coefficient for the linear term (0.23, $p < 0.001$) and, in support of *H1a*, a negative and significant coefficient for the quadratic term (–0.10, $p < 0.05$)[3]. This suggests an optimum in the level of term specificity: neither contracts with a (very) high degree of term specificity, nor contracts with a (very) low degree of term specificity are conducive for such innovation. *H1b* states that the higher the degree of term specificity in a contract, the less likely that the supplier will engage in radical innovation. The results do not support *H1b* (–0.05, ns). Please refer to Figure 1 for the plots of *H1a* and *H1b*.

H2a and *H2b* state that the extent to which the supplier's rewards are linked to its performance positively affects incremental and radical innovation. The results provide support for *H2a* (0.11, $p < 0.05$) and *H2b* (0.41, $p < 0.001$). To further investigate whether pay-for-performance affects the two innovation outcome variables differently, we conducted the *t*-test suggested by Chin (2000)

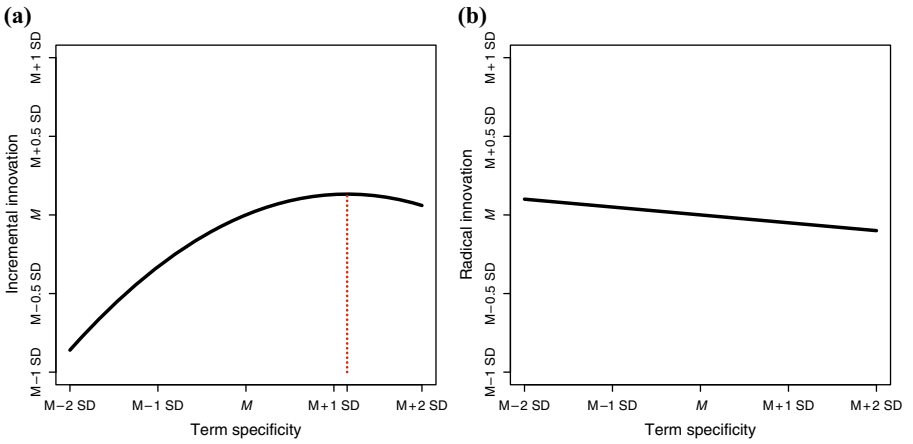

Figure 1.
Effects of term specificity on incremental and radical innovation

Notes: (a) Incremental innovation (*H1a*); (b) radical innovation (*H1b*)

(*t*-statistic = 4.24, df = 106 + 106 − 2 = 210, $p < 0.001$) and the nonparametric bootstrap-based approach (PLS-MGA) suggested by Henseler (2012) ($p < 0.001$). Both tests suggest that two path coefficients differ significantly from each other, indicating that indeed the effect of pay-for-performance is stronger on radical than on incremental innovation, rendering empirical support for *H2c*. Figure 2 depicts our conceptual model with the significance of the relationships.

5. Discussion

Despite the large amount of research on the determinants of contractual governance, our current knowledge about its performance implications is limited, especially in relation to innovation. We address this gap by considering two important contractual characteristics: the level of term specificity and the extent to which rewards are linked to performance.

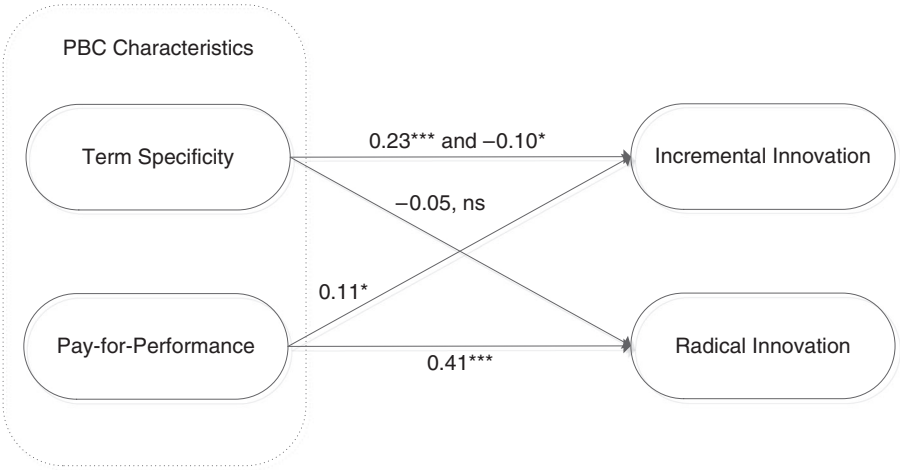

Figure 2.
Framework

Notes: *$p<0.05$; ***$p<0.001$

While increased term specificity is suggested by TCE to curb supplier opportunism, innovation in contrast benefits from more open contracts (i.e. contracts with lower term specificity). To counter the opportunism such open contracts bring, AT suggests the use of contractual incentive schemes, such as performance-based rewards. Together, these variables constitute two interdependent solutions for dealing with opportunism in buyer-supplier relationships. Both solutions are combined in PBCs, the one type of contract that has been argued (but not demonstrated) to be conducive for innovation.

5.1 Theoretical implications

The two characteristics have differing effects on incremental and radical innovation. We find that term specificity has an inverse *U*-shaped relationship with incremental innovation, meaning that if term specificity is too high or too low, the highest possible level of innovation will not be achieved. This observation reinforces findings in intra-firm settings, which indicate that a certain degree of term specificity leads to incremental improvements in processes and outputs (Benner and Tushman, 2003; Jansen *et al.*, 2006). Capturing a certain degree of rules and obligations in contracts makes existing knowledge and skills explicit, enabling more efficient exploitation and faster implementation of incremental changes (Jansen *et al.*, 2006). On the other hand, contrary to prior research in intra-firm settings we find that after a certain point, term specificity negatively affects incremental innovation. Future research should identify whether this pattern of curvilinearity (too high-term specificity being detrimental to incremental innovation) also occurs in intra-firm settings. Furthermore, our results indicate a negative, but not significant, effect of term specificity on radical innovation. Further research is required to establish a relationship (positive or negative) between term specificity and radical innovation.

Regarding performance-based rewards, we find, in line with earlier studies (Abbey and Dickson, 1983; Johnson and Medcof, 2007; Shepherd and DeTienne, 2005), that the extent to which the supplier's rewards are linked to its performance positively affects both incremental and radical innovation. As per our prediction, performance-based rewards affect radical innovation more strongly than incremental innovation. This implies that, more generally, financial incentives of a certain kind affect different types of innovation differently. Future research could be aimed at unraveling what kinds of financial incentives are most effective for each of the innovation types.

Taken together, our empirical results highlight the (differing) effects of the two contractual characteristics on incremental and radical innovation. In other words, the results suggest that different types of innovation require different contractual characteristics. Moreover, this underlines the importance of using TCE and AT collectively rather than separately when trying to explain innovation in buyer-supplier relationships. Incremental innovation requires a level of term specificity which is neither too high nor too low. Adding pay-for-performance clauses also positively affect incremental innovation. Radical innovation benefits from contracts that contain pay-for-performance clauses. In sum, different types of innovation require contracts with both low-term specificity and performance-based rewards; consequently, both types of innovation can be simultaneously pursued through one single contract.

5.2 Managerial implications

Our results have several implications for practitioners. First, the finding that the relationship between term specificity and incremental innovation appears to have an optimum suggests an interesting tension. Buyers must understand the risks associated

with giving the supplier too much freedom and the limitations imposed by an overly detailed contract, and finding the optimal degree of term specificity requires significant managerial skills. The more performance-based rewards are added into the contract, the higher the level of incremental innovation achieved. For radical innovation, buyers must think carefully about incentivizing the supplier via incentive structures: the more performance-based rewards are included into the contract, the higher the level of radical innovation achieved. Organizations need to think about the type of innovation, which they wish to pursue to determine the appropriate level of term specificity, and subsequently develop appropriate financial incentive structures.

6. Limitations and future research

There are several limitations of this study that should be considered in the interpretation of its results. Despite the encouraging results of tests we have reported herein, a few obvious limitations pertain to our data collection procedure: the rather low response rate is a potential weakness; only one industry sector (maintenance service sector) was surveyed; and we were unable to draw on objective data. In summary, this is a call for a replication across other industries which would increase the generalizability of the results, for future studies that complement respondents' self-reports with objective data (such as measures of term specificity derived from the actual content of the contracts and objective measures of innovation).

Further, we have defined and measured innovation as a static outcome rather than a dynamic process that unfolds between the parties with multiple stages consisting of idea generation, idea development and idea implementation (Garud *et al.*, 2013). We expect that earlier stages of the innovation process (i.e. idea generation and development) require lower degrees of term specificity as autonomy is important for the supplier to generate and develop new ideas. On the other hand, the last stage (i.e. idea implementation) would benefit from higher degrees of term specificity as clearly specifying the objectives is important in accelerating their implementation (Jansen *et al.*, 2006). Hence, future research could analyze whether our independent variables have different effects on different stages of the innovation process.

Furthermore, additional research on the relationship between contracts and innovation is required, particularly in conjunction with contingency variables such as the supplier's characteristics or the external environment (e.g. market uncertainty) and the internal environment (climate for innovation) (Das and Joshi, 2007; Wang *et al.*, 2011).

In addition, studies of buyer-supplier relationships benefit from multi-respondent and dyadic data collection (i.e. matched pairs), as individuals across and between organizations may have evaluated constructs differently. Collecting match-pair dyadic data is a daunting task, but might yield additional insights into the nature of the relationships between contracts and innovation outcomes.

Besides addressing the above-mentioned limitations, there are several interesting avenues for future research. First, in contrast to recent studies in intra-firm settings, which found that contractual detail might not be as detrimental for radical innovation as previously thought (Jansen *et al.*, 2006; Zollo and Winter, 2002), we found an insignificant negative effect of term specificity on radical innovation. Future work could focus on whether, and how, contractual term specificity affects radical innovation in inter-firm settings and compare this to results obtained in intra-firm settings. Second, future studies could investigate the effects of different financial incentive structures, such as bonuses and innovation incentives, on innovation. In an intra-firm setting, reward schemes, such as stock ownership and stock options, have been shown to affect

either short-term goals (incremental innovation) or long-term goals (radical innovation) (Sanders, 2001); similar studies could be conducted in an inter-firm setting. Finally, we only tested the effect of formal control on innovation; we did not address the effects of relational governance. IORs governed by contracts that are prone to opportunistic behavior require other governance methods such as the relationship (Al-Najjar, 1995). By keeping the contract open, buying organizations demonstrate that they trust their suppliers to deliver the service as agreed. Relational aspects such as trust, communication, and commitment therefore become important (Mohr and Spekman, 1994). These relational attributes could also affect innovation. For example, parties that interact closely share know-how, which can positively affect innovation (Im and Rai, 2008). Future research could therefore study the interaction between contracts and relational governance elements, rather than testing their effects independently in separate studies.

As more and more organizations govern their IORs by adopting contracts that are intentionally left incomplete, an enhanced understanding of how to design, implement, manage, and control such contracts is critical. The future research opportunities are abundant, and we expect the emerging body of literature on the use and effects of incomplete contracts in general, and PBCs in particular, to grow substantially. Our study is one such contribution; it has increased our understanding of how incomplete contracts affect innovation.

Notes

1. Note that we focus here on (performance-based) contracts in general, where contracted activities or performance (e.g. delivery, quality) may or may not be accompanied by innovations. This as opposed to innovation contracts (Gilson *et al.*, 2009), where innovation is the sole performance outcome.
2. In addition to incentive schemes, which can be designed into the contract *ex ante*, AT also proposes *ex post* mechanisms to curb opportunistic behavior, such as monitoring. In the current research however, we focus on the characteristics of the contract (i.e. *ex ante* contract design).
3. The maximum of the inverse-U relationship between term specificity and incremental innovation is within the observed variable range (i.e. 5.19).

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(The Appendix follows overleaf.)

Appendix

Variables/measurement items	λ	t-value
Incremental innovation (five-point scale)		
To what extent do you agree with the statements below regarding the activities that have been carried out by the supplier (your company) within this maintenance contract?		
1. The supplier/(we) continuously improves the maintenance processes	0.809	37.460
2. The supplier/(we) often refines the delivery of existing products and services	0.863	51.613
3. The supplier/(we) regularly implements small adjustments to existing products and services	0.867	50.723
4. The supplier/(we) improves the efficiency of the products and services that are delivered	0.917	88.596
5. The supplier/(we) contributes to a higher degree of usage and effectiveness of the asset	0.791	28.627
6. The supplier/(we) improves scope management	0.859	42.266
7. The supplier/(we) achieves a higher productivity from the mechanics	0.750	22.795
Radical innovation (five-point scale)		
To what extent do you agree with the statements below regarding the activities that have been carried out by the supplier/(your company) within this maintenance contract?		
1. Creation of a new service within a particular market	0.843	44.985
2. New way of interacting with the client who receives the service	0.861	46.487
3. Changed internal organizational arrangements with the supplier/(our company) to allow their/(our) employees to perform their job properly	0.819	28.591
4. Change in the tangible aspects of the transaction (e.g. new/changed technology)	0.794	23.333
Term specificity (seven-point scale)		
To what extent are the following specifications outlined in this maintenance contract?		
1. The specific persons to be assigned the management and monitoring tasks	0.737	21.265
2. The specific technologies to be contributed by the supplier/(our company)	0.723	15.119
3. How the supplier/(our company) should develop certain resources/technologies	0.876	63.962
Pay-for-performance (seven-point scale)		
To what extent do you agree with the following statements regarding the reward schemes applied in this contract?		
1. The supplier's/(our) rewards are linked to the outcomes of the service delivered	0.649	14.170
2. The supplier/(we) has sufficient financial incentives to improve/develop the service	0.757	24.674
3. The supplier/(we) is compensated for delivering better service quality	0.791	22.363
4. The supplier's/(our) rewards are linked to the degree of improvement in its/(our) performance	0.835	25.238
5. We have agreed-upon performance bonuses on top of the regular payment schemes when performance levels exceed targets	0.775	23.785
6. The supplier/(we) is financially rewarded for developing alternative/new ways of achieving the performance targets	0.814	31.147
Trust (five-point scale)		
To what extent do you agree with the following statements regarding the degree of trust between your company and the supplier/(buyer)?		
1. Our relationship with this supplier is characterized by high levels of trust	0.752	18.239
2. The parties generally trust that each will abide by and work within the terms of the contract	0.765	24.138
3. The parties are generally skeptical of the information provided by the other (R)	0.647	12.847
4. The parties trust each other to have the required resources (such as capital and labor)	0.781	28.915

Table AI.
Scale items

(*continued*)

Variables/measurement items	λ	t-value
5. The parties recognize and acknowledge each other's reputation and capabilities	0.698	16.185
6. The parties do whatever is necessary to ensure the success of the collaboration even if it involves performing tasks that they had not previously agreed on	0.769	26.865
7. Neither party withholds information that is needed to perform well	0.721	19.358
8. Neither party exploits to its advantage any (temporary) shortcomings of the other party	0.726	17.474
9. The parties work hard to help each other solve problems that may influence the success of the collaboration	0.842	37.538
Supplier risk-aversion (single-item)		
To what extent do you agree with the following statements regarding the supplier's/(your company's) predisposition toward risk?		
1. The supplier/(we) prefers the "tried and true" paths		
Transactional complexity (single-item)		
1. How would you evaluate the complexity of the products and services delivered by the supplier/(your company) within this maintenance contract (from very low to very high)?		

Table AI.

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