CO-CREATING VALUE FROM R&D SERVICE OFFERINGS: THE MODERATING ROLE OF JOINT LEARNING IN SUPPLIER-CUSTOMER INTERACTIONS

Marko Kohtamäki*
Professor / Visiting Professor
University of Vaasa, Department of Management /
Entrepreneurship and Innovation, Luleå University of Technology
PO Box 700, FI-65101 Vaasa, Finland
E-Mail: marko.kohtamaki@uwasa.fi

Jukka Partanen
Post-doctorate researcher, Aalto University, School of Economics
PO Box 21250, 00076, Aalto, Finland
E-mail: jukka.partanen@aalto.fi

ABSTRACT

This study considers value co-creation as joint learning and seeks evidence of the positive moderating role of value co-creation in the link between R&D service offerings and supplier sales performance in supplier-customer relationships. The findings obtained from a structural analysis of 91 supplier-customer relationships indicate that supplier R&D service offerings do not create value *per se* but require relational capabilities, namely, joint learning, to enable value co-creation. The results demonstrate that joint learning positively affects the link between the supplier's R&D service offerings and supplier sales performance in a supplier-customer relationship. The results highlight the importance of joint learning in R&D service interactions and suggest that firms need joint learning capabilities to co-create value from R&D service offerings.

Keywords: R&D services; value co-creation; joint learning; sales performance; supplier-customer relationships; customer relationship

Competitive paper

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INTRODUCTION

The literature on industrial services and solutions suggests that manufacturing companies are migrating from product-dominant business models to service-dominant value creation logics. The individualization of end-customers' needs and increased market competition drive companies to offer customized products, services and solutions (Brady et al. 2005; Davies et al. 2007). When developing more customized, comprehensive and often complex solutions such as propulsion systems or electrical engines, industrial companies need complex R&D capabilities to create solutions that offer use-value for customers (Gebauer & Friedli 2005; Lusch et al. 2010). As companies offer more customized solutions, the role of R&D services (e.g., prototype development and feasibility studies) increases in significance (Johnsen 2009; Kohtamäki et al. 2013). As a result, companies have incorporated R&D services into their strategies and offerings.

However, offering R&D services *per se* are insufficient to generate sales performance. Companies need to engage their customers in the processes of value co-creation (Carbonell et al. 2009; Grönroos 2008) and to generate or appropriate (Mizik & Jacobson 2003) value (e.g., revenues, profits, referrals) from their offerings (Vargo & Lusch 2004). This requirement is particularly evident in exchanges of R&D services in which value is co-created through a series of interactions between the supplier and the customer (Kindström & Kowalkowski 2009) that are characterized by information asymmetries (Athaide & Klink 2009). Thus, prior studies suggest that successful co-creation in the context of industrial R&D services requires relational capabilities (Marsh & Stock 2006; Song & Di Benedetto 2008) such as the capacity for joint learning (Selnes & Sallis 2003). Nevertheless, the recent literature on value co-creation tends to be dominated by conceptual studies (Etgar 2008; Vargo & Lusch 2008) and in-depth case studies (Blazevic & Lievens 2008; Edvardsson et al. 2008). Hence, there is little empirical evidence regarding the core capabilities that enable value co-creation or the effect of R&D services on sales performance, particularly at the level of customer relationships (Belderbos et al. 2004).

In the present study, we focus on the sales impact of R&D service offerings and the capabilities required to facilitate the co-creation of value. Our objective is to answer the following research question: *What is the role of joint learning in the link between the supplier's R&D service offerings and sales performance at the level of customer relationships?* We conceptualize value co-creation as a joint learning capability because prior studies note that learning and knowledge sharing are vital to value co-creation (Lusch et al. 2010) and that value creation from tacit R&D resources requires joint learning. For instance, Payne et al. state, *"Our research highlights the roles of customer and supplier; how, together, they create value, and the importance of core competences such as learning and knowledge"* (Payne et al., 2008: 93). In brief, joint learning consists of phases of relationship learning: knowledge sharing, joint sense-making and integration into relationship-specific memory (Selnes & Sallis 2003). We developed a research model that links supplier R&D service offerings with sales performance at the level of customer relationships and that tests the moderating effect of joint learning on this link between R&D service offerings and sales performance.

The motivation for our study is threefold. First, the early research on R&D collaboration examines the content of cooperation (i.e., R&D/new product development) and the process of cooperation (i.e., supplier involvement, customer involvement/cooperation) in analyzing the single concept of R&D collaboration (i.e., R&D alliances, R&D cooperation, supplier/customer

involvement). Prior studies made no distinction between R&D service offerings (i.e., R&D strategy) and the form of collaboration (i.e., the relational structure). We separate these constructs to study the Cartesian strategy-structure fit through moderation (Gerdin & Greve 2004). This distinction is important because collaboration often determines company strategy although the structure should follow the strategy (Chandler 1962), even in the case of R&D. Second, the existing empirical studies on value co-creation often investigate the performance implications of the latter as firm-level phenomena (Antioco et al. 2008; Fang et al. 2008). However, considering firm-level performance attributes can yield significantly misleading results because the R&D services in a single customer relationship are not directly linked to firm-level outcomes. Hence, we adopt the supplier-customer relationship as our unit of analysis (Aulakh & Kotabe 1997; Medlin et al. 2005). Our approach is justified by the service literature, which suggests that in a service business, the value is co-created in the relationship between the customers and their suppliers (Grönroos 2008; Payne et al. 2008). Third, there is no consensus regarding whether customer relationships contribute positively or negatively (Christensen 1997) to supplier innovation given that current customer relationships may draw companies toward the exploitation trap (Knudsen 2007). Bearing in mind Knudsen's (2007) important findings, we intend to test whether suppliers can circumvent this exploitation trap by co-creating value in a favorable facilitation of joint learning.

This study contributes to the literature on co-creation in the context of industrial R&D service interactions (Belderbos et al. 2004; Edvardsson et al. 2011). We extend the work in this field by providing empirical evidence of the effect of joint learning on the link between R&D service offerings and supplier sales performance at the level of a single supplier-customer relationship. In brief, we argue that co-creation not only requires *"a deep understanding of customer experiences and processes"* from the supplier (Payne et al 2008: 89) but also necessitates joint learning capabilities (i.e., knowledge sharing, joint sense-making, and integration to relationship-specific memory) from both parties.

CO-CREATING VALUE FROM R&D SERVICES BY FACILITATION OF JOINT LEARNING

SUPPLIERS' R&D SERVICE OFFERINGS

Prior studies have generally defined services as something consumed but not possessed by customers (Barry & Terry 2008). Thus, services do not involve ownership (Edvardsson et al. 2005) but are consumed when produced in an interaction between the supplier and the customer (Grönroos 2008; von Zedtwitz & Gassmann 2002). Prior research discusses R&D services by examining the subject in connection with vertically integrated R&D (De Luca et al. 2010; Hashai & Almor 2008), R&D cooperation or R&D alliances (Un et al. 2010; Kohtamäki et al. 2013), early supplier involvement (Johnsen, 2009), customer involvement (Carbonell et al. 2009; Nicolajsen & Scupola 2011), innovation cooperation (Tether, 2002), or R&D services offered by the supplier (Homburg et al. 2003; Oliva & Kallenberg 2003; Samli et al. 1992).

At this point, we need to distinguish our study from the research conducted in the well-established fields of early supplier involvement and R&D cooperation. The literature on early supplier involvement examines the process from the perspective of the customer and considers

how customers involve suppliers in early stages of product development (Andersen & Drejer 2009; Song & Di Benedetto 2008), whereas the field of R&D cooperation mainly investigates the horizontal relationships between R&D partners (Belderbos et al., 2004; Sampson, 2007; Un et al., 2010). We build on the less established literature on value co-creation (Payne et al. 2008; Wilhelm & Kohlbacher 2011) and customer involvement (Carbonell et al., 2009; Nicolajsen & Scupola, 2011) and define R&D service offerings as those R&D-related activities that complement the products of an industrial supplier and that are consumed but not possessed by an industrial customer (Homburg et al., 2003; Oliva & Kallenberg, 2003; Samli et al., 1992).

VALUE CO-CREATION AND JOINT LEARNING

Prior studies have conceptualized value in various ways (Grönroos & Helle 2010). For instance, Porter (1985) defines value as the amount that buyers are willing to pay for the offerings of the supplier firm, whereas Payne et al. (2008) argue that value emerges as a product or a service is consumed. Gupta and Lehman (2005) suggest that value can be divided into two categories: value for the customer and financial value for the supplier. These two types of value are interrelated because the value created for the customer affects the financial value generated for the supplier (Grönroos 2011b). In this study, we investigate the financial value for the supplier by adopting supplier sales performance at the level of a single-customer relationship as our dependent variable, as this variable reflects the factual and calculative value generated by the relationship.

A notable characteristic of value is that it is often created in the interactions between suppliers and customers (Grönroos, 2008; Vargo & Lusch, 2008). Prior studies used the concept of co-creation to address the value created in supplier-customer or manufacturer-consumer interactions. Scholars have defined co-creation as a *"joint creation of value by the company and the customer"* (Prahalad & Ramaswamy, 2004: 8). The co-creation of value can emerge via co-designs, co-inventions or co-developments to which the supplier and the customer both contribute (Lusch & Vargo, 2006); co-production based on the logic of value chains and systems (Lusch & Vargo, 2006); comprehensive customer services (Grönroos, 2008); the consumer's emotional engagement in marketing campaigns; or the provision of customer-involving experiences (Payne et al., 2008). We adopt the concept of co-creation to consider the value created from a supplier's R&D service offerings.

Moreover, we consider the concept of joint learning in conceptualizing value co-creation because the importance of learning in co-creation has been widely acknowledged by prior scholars in the field (Carbonell et al., 2009; Lusch et al., 2010; Payne et al., 2008). The co-creation process is connected to the knowledge creation processes that occur between the supplier and the customer, in which value is created from tacit R&D knowledge (Grönroos 2011a). Based on organizational learning theory, Selnes and Sallis (2003) developed a conceptualization of relationship learning and a means of measuring this type of learning. They defined relationship learning as *"a joint activity between a supplier and a customer in which the two parties share information, which is then jointly interpreted and integrated into a shared relationship-domain–specific memory"* (Selnes & Sallis, 2003: 80). This definition is consistent with the typical definitions of organizational learning (Crossan et al. 1999) but uses the supplier-customer relationship as the unit of analysis. In brief, relationship learning is relational learning process including the

dimensions of knowledge sharing, joint sense-making, and knowledge integration into relationship-specific memory. We employ the concept of relationship learning in this study but label it "joint learning" because this construct captures the joint learning processes that occur between the supplier and the customer.

RESEARCH MODEL AND HYPOTHESIS

Building on the Cartesian contingency discussion (Gerdin & Greve 2004), we suggest that solution customization, which manifests in the form of R&D service offerings, should be complemented by co-creation capabilities, namely joint learning (Dyer & Singh 1998; Madhok & Tallman 1998). In our empirical model, we control not only for the direct relation between R&D service offerings and supplier sales performance but also for the mediating effect of joint learning on the link between R&D service offerings and supplier sales performance. Prior studies have demonstrated that joint learning directly yields competitive advantage based on collaboration (Chang & Gotcher, 2007) and affects relationship performance (Selnes & Sallis, 2003). Finally, by testing the full model and controlling for the mediating effect along with other control variables, we intend to demonstrate that the existing research model is the only theoretically consistent and empirically solid option.

THE MODERATING ROLE OF JOINT LEARNING IN THE LINK BETWEEN R&D SERVICES AND RELATIONSHIP PERFORMANCE

The literature on R&D cooperation between manufacturers and customers posits organizational learning as a mechanism that feeds new product development (Marsh & Stock 2006) and is required for successful product development. For instance, Knudsen (2007: 121) notes that *"to enable the invention of new products the NPD process requires creation and utilization of knowledge"*. However, most of the existing R&D studies neglect the role of joint learning, although some studies highlight co-creation as important to the process of creating value from services that are characterized by tacit knowledge (Knudsen, 2007; Payne et al., 2008; Wilhelm & Kohlbacher, 2011).

The service literature suggests that value is co-created in supplier-customer interactions (Lusch et al., 2010; Payne et al., 2008). A customer's positive perception of value is often developed through co-creative and interactive processes, where customer participates thereby enabling the origination of positive customer experience. We extend this argument by suggesting that the co-creation of value from supplier R&D service offerings requires joint learning capabilities that enable the supplier and the customer to share and make sense of new knowledge and to integrate that knowledge into existing knowledge structures. Our argument is that service offerings *per se* do not create value; instead, the supplier's R&D service offerings can be understood as potential value to be realized (Grönroos, 2008) in the form of customized products or services that fit the needs of the customer.

Some studies have highlighted the importance of relational learning in co-creation activities. For example, Payne et al. (2008: 84) suggest that *"dialog should be seen as an interactive process of learning together"* and that *"the customer engages in a learning process based on the experience that the customer has during the relationship"* (See also Ballantyne, 2004). Studies

note that joint learning is particularly important in surface-level encountering processes, such as when the supplier and the customer meet, interact and jointly create new knowledge from the supplier's R&D services.

Moreover, joint learning is necessary because R&D exchanges involve tacit knowledge and thus feature significant ex-ante information asymmetries (Knudsen 2007; Kogut & Zander 1992). Tacit knowledge is known to be particularly difficult to communicate, make sense of and integrate into organizational memory (Marsh & Stock 2006; Nonaka & Takeuchi 1995). Often, before the R&D exchange occurs, the supplier has insufficient knowledge of the needs of the customer, particularly the end-customer (i.e., the customer's customer), whereas the customer has insufficient knowledge of the resources and capabilities of the supplier providing the R&D services (Athaide & Klink 2009; Kohtamäki et al. 2013; Stump et al. 2002). Prior studies suggest that relational capabilities (Marsh & Stock 2006; Un et al. 2010) such as joint learning (Grönroos, 2008: 298; Selnes & Sallis, 2003) may be used to decrease information asymmetries and co-create value from supplier R&D service offerings. In these instances, value is co-created through dialogue-based joint learning activities (Ballantyne, 2004).

In summary, joint learning increases the supplier's understanding of the customer's needs, increases the knowledge-sharing between the supplier and the customer, and enables the supplier and the customer to co-create value from the supplier's R&D service offerings. Furthermore, increased value may improve the customer's experience in the customer-supplier relationship, increase customer satisfaction and loyalty and finally, increase the supplier's revenues through increased services and product and solution sales (Heskett, Jones, Loveman, Sasser, & Schlesinger, 2008; Normann & Ramírez, 1993). Thus, we hypothesize the following:

H_1: Joint learning will positively moderate the link between R&D services and sales performance in the supplier-customer relationship.

RESEARCH METHOD

SAMPLE AND DATA COLLECTION PROCEDURE

The machine and equipment manufacturing industry (SIC 28) in Finland was chosen as the context for this study because product manufacturing companies typically customize their products and involve customers in their R&D operations, and thus, these companies offer R&D services to their customers. As the unit of analysis, we selected the supplier-customer relationship. As our key respondents, we use the managers at the supplier firms who oversee the evaluated customer relationships. Specifically, of the key respondents, 19% were working as managing directors or production managers, 61% were working as key account/sales managers or business developers, 12% were working as R&D managers, and 8% remained unclassified.

Before sending out the web-based questionnaire, we contacted the companies by phone. During the data collection process, we sent two reminders to the companies. A total of 91 questionnaires were returned; thus, we obtained a satisfactory response rate of 23% (Baruch 1999). After we had accounted for refusals, the final response rate was 25%. Despite the satisfactory response rate, we analyzed the data for non-respondent bias by comparing the actual respondents to the

non-respondents with respect to three variables (revenue, profit and balance sheet value) and by comparing the first one-third of the respondents to the last one-third with respect to the key study variables (Armstrong & Overton 1977; Werner et al. 2007). No significant differences were found between the respondents and non-respondents.

In our data, a typical respondent firm generates an annual turnover of approximately 13.6 million EUR (median value), serves 120 customers, and employs a staff of 100 while producing a return on investment of 19.4%. In the evaluated customer relationship, the suppliers rate their switching time as relatively high (6 months) given that these companies are product manufacturers. The suppliers' factories (130 km) are often located near their customer bases. Product business, service business and subcontracting account for 63%, 20% and 17%, respectively, of the supplier's revenues. Finally, the data correspond to small- and medium-sized product manufacturing business units that offer services for nearby large industrial customers. The suppliers are in an early stage in the process of migrating from a product-dominant business model to a service-dominant one.

METHODS, CONSTRUCT MEASURES, VALIDITY AND RELIABILITY

The present study applies a two-step approach to structural equation modeling (Anderson & Gerbing 1988; Song & Montoya-Weiss 2001). First, we verify the constructs; then, we test and report on the structural model. We apply the software program AMOS 18.0 to conduct the analysis and use Stata 11.0 for robustness tests.

This study primarily uses measures that have been adopted from prior studies. The items, the constructs and their theoretical roots are reported in Appendix A. For the joint learning and relationship performance variables, we used 7-point Likert scales ranging from "fully disagree" to "fully agree". For the R&D services, we asked the respondents to evaluate the emphasis on R&D services when they were marketing their services and products using Likert scales (0=not offered, 1=not significant at all, 7=very significant). This service-specific evaluation of the activity is similar to those used in prior studies (Homburg et al. 2002; Homburg et al. 2003; Martínez-Tur et al. 2001) and was further validated by insights from four exploratory case studies in which we performed case observations and interviews (a total of 23 observations/interviews). We measured the control variables using fact-based measures. All of the measures are reported in the appendix.

The constructs used for this study were adapted from prior studies. The items were also translated from English into Finnish and then back-translated by another person to ensure translation equivalence (Brislin 1970). In addition, the constructs that were modified (i.e., R&D service offerings and supplier sales performance) were pre-validated. In the pre-validation process, we used the content validity index (CVI) in accordance with the guidelines established by Polit, Beck and Owen (2007). The pre-validation process called for nine experts from the research field of strategy and service marketing to assess whether each item fit the definition of the construct that the item was intended to measure. We developed and distributed a web-based questionnaire that the experts used to assess the item-construct fit on a scale ranging from one to four (1 = not relevant, 2 = somewhat relevant, 3 = quite relevant, 4 = highly relevant). In three validation rounds, we found that the measures were methodologically rigorous. After collecting

the data, we calculated the content validity index (average I-CVI) and compared the average I-CVI (I-CVI/AVE) value to the threshold value of .8 (Davis 1992; Polit et al. 2007). Every construct exceeded the threshold. In addition, before the data were collected, three business managers from manufacturing companies evaluated and commented on the questionnaire.

The present study defines R&D service offerings as those R&D-related activities that complement the products of an industrial supplier and that are consumed but not possessed by an industrial customer (Homburg et al., 2003; Oliva & Kallenberg, 2003; Samli et al., 1992). Each item reflects a particular R&D service. These include product tailoring services, feasibility studies, research services and problem analyses. The questionnaire items were adopted from Homburg et al. (2003) but were also pre-validated by experts. In applying the domain-sampling model, we performed a factor analysis using principal axis factoring with maximum likelihood rotation. The factor analysis demonstrated that the construct has a uni-dimensional structure. In the factor analysis, all of the items were loaded above .40 onto the main factor. Moreover, the AMOS model exhibited good model fit, which suggests that the construct validity is high ($\chi 2$ = 1.15, degree of freedom [df] = 2, p = .56, $\chi 2$/df = 0.57, RMSEA = .000, GFI = .99, CFI = 1.00, IFI = 1.00) (Bollen 1989; Pugh et al. 2002; Hu & Bentler 1999). The item loadings were statistically significant, and the construct and its items exhibited satisfactory levels of reliability and validity.

Joint learning was operationalized as a multi-dimensional construct composed of three sub-dimensions: knowledge sharing, joint sense-making and integration into a relationship-specific memory. All of the items were adopted from Selnes and Sallis (2003). The items used to measure the theoretical dimensions were constructed and averaged into three parcels based on the results of the principal axis factoring (Little et al. 2002) with maximum likelihood rotation, which validated the three-dimensional factor structure. In the factor analysis, all of the items loaded above .40 onto their main factors without significant side-loadings (<.40). All of the factors showed satisfactory Cronbach's alpha values that were above .7 (Nunnally & Bernstein, 1994). Furthermore, the AMOS analysis indicated good model fit, suggesting high construct validity ($\chi 2$ = 48.16, degree of freedom [df] = 40, p = .18, $\chi 2$/df = 1.20, RMSEA = .048, GFI = .91, CFI = .99, IFI = .99). The item loadings were statistically significant ($p \leq 0.001$). We also tested the behavior of the construct using PLS modeling, which allows researchers to apply constructs of a formative nature. The results obtained using the formative measurement model was consistent with the results obtained using the reflective measurement model. Different dimensions had almost equally important effects on the latent construct (with path coefficients from .392 to .395). We used a reflective measurement model because joint learning requires the existence of all of the dimensions and is therefore measured as the shared variance among knowledge sharing, joint sense-making and integration into relationship-specific memory (the reflective construct) (Borsboom et al. 2004; Law Wong, Chi-Sum, & Mobley, William H. 1998). Overall, the construct and its items show satisfactory levels of reliability and validity.

Sales performance was measured using items adapted from Covin, Prescott and Slevin (Covin et al. 1990) and Gupta and Govindarajan (1984). Following prior studies (Aulakh & Kotabe, 1997; Medlin et al., 2005), we transformed the items to measure the supplier sales performance for a particular customer relationship. Moreover, we asked the respondents to evaluate the importance of a specific measure (scale 1-7) and asked them to rate their satisfaction with their firms'

performance in the customer relationship using a particular measure (scale 1-7). For the final measure, we multiplied the ratings for importance and satisfaction to determine the weighted average performance score for each case. Two items were used to measure supplier sales performance: the supplier sales level in the customer relationship and supplier sales growth in the customer relationship. Obviously, because the items are highly correlated, the construct is uni-dimensional (i.e., the items loaded significantly above .4 onto the main dimension in the factor analysis). In addition, the items loaded significantly when we tested the full measurement model. Finally, we should note that subjective and objective performance measures are strongly correlated (Murphy & Callaway 2004) and that the level of sales performance in a customer relationship would be difficult to reliably measure using any method other than the supplier's subjective evaluation. We can conclude that our measure of supplier sales performance in the customer relationship exhibited acceptable reliability and validity.

To consider the construct discriminant validity, we tested the measurement model with all of the main constructs. The full measurement model exhibited acceptable fit: $\chi 2 = 137.121$, degree of freedom [df] = 112, p = .054, $\chi 2/df = 1.18$, RMSEA = .050, GFI = .86, CFI = .97, IFI = .97 (Bollen 1989; Hu & Bentler 1999). All of the items loaded above .05 onto their main constructs, and the item loadings were statistically significant. In summary, the analyses demonstrated that all of the constructs and items are satisfactory in terms of reliability and validity.

In addition, we controlled for several variables. More specifically, we controlled for the geographical distance between the supplier's factory and the customer. We did so because we suspected that greater supplier proximity could result in an improved relationship, greater customer value and hence, higher sales performance. We also controlled for customer dependency, which is reflected by the supplier's switching time for the customer (six months on average) because we expected greater customer dependence on the supplier's resources to potentially generate better opportunities for sales growth for the supplier. In addition, we controlled for the mediating effect of joint learning and the direct effect of R&D service offerings on supplier sales performance.

Given the threat that common method variance poses to the interpretation of the survey results, we applied controls during the data collection process and at the beginning of the analysis by testing the data for possible bias (P. Podsakoff et al. 2003). We tested for the existence of common method variance by comparing the single-factor model with the original research model because this technique is considered preferable to Harman's one-factor test (Korsgaard & Roberson 1995; McFarlin & Sweeney 1992; P. Podsakoff et al. 2003). We found that our research model had a significantly better model fit ($\chi 2 = 200.59$, degree of freedom (df) = 154, p = .007, $\chi 2/df = 1.30$, RMSEA = .058, GFI = .83, CFI = .94, IFI = .94) compared to the single-factor model ($\chi 2 = 393.96$, degree of freedom (df) = 151, p = .000, $\chi 2/df = 2.61$, RMSEA = .134, GFI = .68, CFI = .68, IFI = .68), suggesting low common method variance. In addition, we tested our research model using a method factor approach (the marker variable approach) (Podsakoff et al. 2003; Rönkkö & Ylitalo 2011). As marker variables, we used customer seminars (Service share from relationship revenue), warranty (Service share from relationship revenue), and insurance service (Service share from relationship revenue) as these variables provided a good proxy for the method variance in our data and research model. Adding the method factor resulted in poor model fit ($\chi 2 = 284.80$, degree of freedom (df) = 205, p = .000, $\chi 2/df = 1.39$, RMSEA =

.066, GFI = .801, CFI = .91, IFI = .91) and did not significantly change the path coefficients or statistical significances, which suggests that significant method variance is not present in the data (Podsakoff et al., 2003; Rönkkö & Ylitalo, 2011).

RESULTS

This section presents the correlation matrix for the constructs used in this study, reports the structural model and interprets the plotted results. Table 1 presents the correlations between the given constructs and the control variables and demonstrates that the highest correlation between the independent variables (supplier's R&D service offerings and joint learning) is .44. Because of this moderate correlation between the independent variables, we tested for multicollinearity using the variance inflation factor (VIF) (Tabachnick & Fidell 2007). The threshold value for the VIF index is 10; in this study, the value for each independent variable is below 2. These observations suggest that the research model is free of multicollinearity.

Table 1. Correlations among the constructs and control variables.

		1	2	3	4	5	6
1	Customer's dependency on the supplier	1					
2	Distance from supplier's factory to the customer	-0,02	1				
3	Supplier R&D service offering in the relationship	0,13	0,00	1			
4	Joint learning	0,00	-0,08	0,44**	1		
5	Supplier R&D service offerings in the relationship * Joint learning	0,10	0,04	0,35**	0,26*	1	
6	Sales performance	0,03	-0,05	0,13	0,02	0,27**	1

**$p \leq 0.01$ *$p \leq 0.05$ (two-tailed)

We began the structural analysis by controlling for six different effects on the dependent variable. We controlled for the effects of the distance between the supplier's factory and the customer (β= -.07; n.s.), the customer's dependency on the supplier (β= -.08; n.s.), and the supplier's sales performance within the context of the supplier-customer relationship. However, these effects were small and were not significant.

Moreover, we controlled for the direct effects on the main constructs and the sales performance variable. The model demonstrates that the supplier's R&D service offerings had no direct effect on the supplier's sales performance (β= .02; n.s.). Yet the results demonstrate a significant effect of R&D service offerings on joint learning (β= .53; $p \leq .001$). However, joint learning has no direct effect on supplier sales performance (β= .16; n.s.). In addition, we controlled for the direct effect of the supplier's R&D service offering and of joint learning on their interaction variable.

Table 2. Path coefficients and statistical significance from the structural analysis.

Hypothesis and controlled relationships	Path from	To	Final Research model	
			Path Coefficient	t-value
	Distance of the supplier's service operations base from the customer	Supplier sales performance	-.07	-0.61
	Customer's dependency on the supplier	Supplier sales performance	-.08	-0.64
	Supplier R&D service offering in the relationship	Supplier sales performance	.02	0.09
	Supplier R&D service offering in the relationship	Joint learning	.53***	3.96
	Joint learning	Supplier sales performance	.16	0.98
H1	Supplier R&D service offering in the relationship * Joint learning	Supplier sales performance	.39**	2.78
R^2 Joint learning			.28	
R^2 Supplier's sales performance in the relationship			.23	

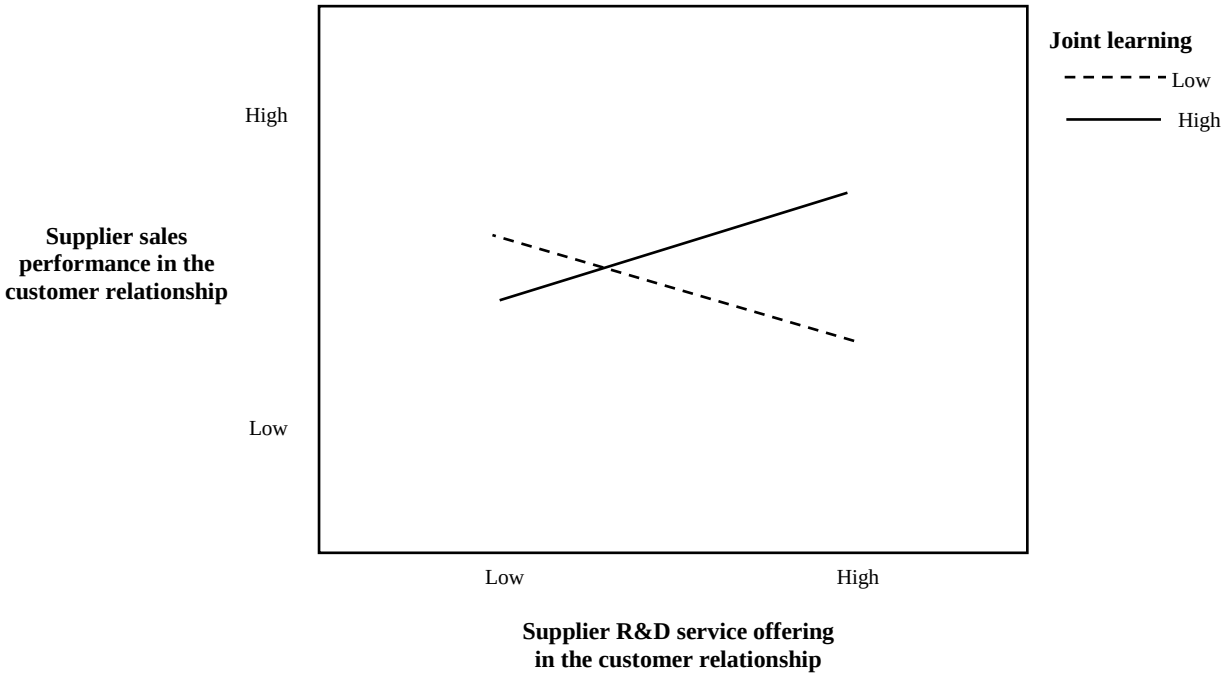
***$p \leq 0.001$ **$p \leq 0.01$ *$p \leq 0.05$ (two-tailed)

Our model demonstrates support for the moderating effect of joint learning on the link between R&D service offerings and supplier sales performance. Our results demonstrate clear evidence of the positive moderating role of joint learning (β= .39; $p \leq .01$). In the model, the constructs explain 28% of joint learning and 23% of supplier sales performance in the customer relationship. Our research model demonstrated acceptable fit when the control variables were included ($\chi 2$ = 203.23, degree of freedom (df) = 161, p = .014, $\chi 2$/df = 1.26, RMSEA = .054, GFI = .83, CFI = .95, IFI = .95) and even better fit without the non-significant controls, which add noise ($\chi 2$ = 154.03, degree of freedom (df) = 126, p = .045, $\chi 2$/df = 1.22, RMSEA = .050, GFI = .85, CFI = .96, IFI = .96).

We plotted the interactions as suggested in prior studies (Brambor et al. 2006; Mitchell et al.

2008). For the interaction, we applied the product term approach and created a product term from mean-centered and averaged R&D service offerings and mean-centered and averaged joint learning (Song & Di Benedetto 2008). Finally, we plotted the interactions using standardized path coefficients (Figure 2). Figure 2 demonstrates the direction of the moderation, suggesting that the supplier's R&D service offering needs support from joint learning to positively affect sales performance. With low levels of joint learning, R&D services have a slightly negative effect on supplier sales performance. Negative effects may result from unsuccessful R&D projects, which use customer resources such as time and money but do not create value. Such negative effects cause dissatisfaction, which negatively affects the supplier's product, service and solution sales for the particular customer. Based on these results, it appears that joint learning positively moderates the effect of supplier R&D service offerings on supplier sales performance, enabling value co-creation from the suppliers' R&D service offerings. Figure 2 confirms our hypothesis 1.

Figure 2. The moderating effect of joint learning on the link between R&D service offerings and supplier sales performance.



As robustness checks, we plotted the interaction using Stata 11.0. The Stata analysis yielded results similar to those of the AMOS analysis and confirmed the positive and significant marginal effect of joint learning on the relation between R&D service offerings and supplier sales performance. In addition, we controlled for the potential non-linearity of the effects but found only weak sings of non-linearity between R&D service offering and supplier sales performance, which was non-significant. In addition, we tested the moderating effect of joint learning on the relationship between R&D services and supplier sales performance. The interaction was non-significant, whereas marginal effects were significant. Yet, the non-linearity

was somewhat weak and the direction of effect was similar as in linear interaction. Moreover, we tested the research model with additional controls variables, such as relational capital and the proximity of the service offering unit form the customer. These controls added noise into the research model, and weakened the model fit, but had no significant impact neither on the direction nor strength of the hypothesized moderation. Finally, the research model was tested also without any control variables, where the main effects remained significant suggesting that the results were independent from the impact of control variables. All in all, we can safely conclude positive interaction between R&D service offering and joint learning.

DISCUSSION AND IMPLICATIONS

THEORETICAL CONTRIBUTION

The present study considered the sales performance impact of suppliers' R&D service offerings and the role of joint learning as a form of value co-creation. Our study makes three distinctive contributions to the literature on value co-creation through suppliers' R&D service offerings.

First, this study is one of the rare empirical attempts to provide evidence of the moderating relational mechanisms involved in the co-creation of value from a supplier's R&D service offering. By demonstrating the important role of joint learning in the relationship between the supplier's R&D service offering and sales performance, we extend recent conceptual studies on service co-creation (Lusch et al., 2010) and R&D service interactions (Belderbos et al. 2004; Edvardsson et al. 2011; Un et al. 2010). We conclude that joint learning is required when the supplier and the customer create value together (i.e., through interactions between the supplier and the customer). Service value creation is then reflected in the sales performance of the supplier.

Second, and more importantly, our study contributes to the co-creation literature by conceptualizing co-creation as joint learning. Although knowledge sharing has been documented as critical in the R&D collaboration literature (Andersen & Drejer 2009; McAdam et al. 2008), we argue that knowledge sharing alone cannot ensure successful co-creation. On the contrary, our findings suggest that successful value co-creation also requires joint sense-making as well as the integration of knowledge into relationship-specific memory, both of which are sub-processes of joint learning. Hence, we extend Payne et al.'s (2008) work, which suggests that the value co-creation process should incorporate 'a deep understanding of customer experiences and processes' (Payne et al 2008: 89) and that co-creation requires learning from both parties. We do so by demonstrating the important moderating role of joint learning (i.e., knowledge sharing, joint sense-making, and knowledge integration into relationship-specific memory) in the context of knowledge-intensive, information-asymmetric services. In brief, the present study demonstrates how joint learning may serve as the core 'encountering process' (Payne et al., 2008: 85) of value co-creation in the complex context of R&D service interactions.

Third, our study contributes to the ongoing debate regarding the value of R&D collaboration. The majority of the existing studies does not distinguish between the R&D service strategy and service structure but instead focus on the single construct of R&D collaboration, supplier involvement or customer involvement. In contrast, this study makes a clear distinction between

R&D strategy (i.e., R&D service offerings) and relational structure (i.e., joint learning), challenging the approach adopted in prior studies. Our approach to R&D service strategy and structure may provide fruitful avenues for further research.

MANAGERIAL IMPLICATIONS

This study has important practical implications for strategic managers of industrial firms that intend to create value by offering R&D services. These implications are particularly relevant for most manufacturing companies because customer needs in today's industrial markets typically involve customized and mass-customized solutions rather than standardized goods (Brady et al. 2005; Davies et al. 2007; Kohtamäki et al. 2013). Our results highlight the importance of co-creation in the context of R&D service interactions. By highlighting the critical role of joint learning in R&D service interactions, our results emphasize the importance of customer relationship management in complex R&D services.

More specifically, we find that the joint learning process and its dimensions must be in place for the value co-creation process to succeed. The results suggest that the value co-creation process requires relational learning processes that make it possible to share and interpret knowledge and to integrate that knowledge into relationship-specific structures. Thus, the study presents a new challenge to relationship managers on both sides (i.e., the supplier and the customer), asking them to implement shared learning processes between partners. Companies may wish to compare their operations with the practices of Japanese car manufacturers such as Toyota, Nissan and Honda (Dyer & Hatch, 2004; Sako, 2004). Our study highlights the importance of these joint learning capabilities, which are particularly important to individuals operating as boundary persons (i.e., those interacting with the current clientele). Key account managers should understand the mechanisms of joint learning processes; however, they also need the tools to integrate their customers into product or service development processes.

LIMITATIONS AND RESEARCH IMPLICATIONS

Our study, like every study, has limitations that must be considered. First, the present study considered only the moderating effect of joint learning on the relation between R&D service offerings and sales performance. The importance of joint learning was evident from our findings; however, our interpretations obviously only indicated the effects of joint learning. Hence, future studies could consider other relational capabilities, such as joint action, as potentially moderating the effect of R&D services. Second, although our measures of R&D services and joint learning functioned at an acceptable level in this study, future research should continue to develop better scales. Both R&D service offerings and joint learning are important phenomena and deserve proper measures. Third, quantitative methods may be incapable of capturing the full complexity and variety of the mechanisms embedded in supplier-customer relationships. Therefore, we encourage researchers to use in-depth case studies to identify these mechanisms. Fourth, our data were collected from supplier-customer relationships. Future research would benefit from multi-level data and analysis that examines relational mechanisms together with company-level outcomes. Finally, our results may be limited by our approach in that we separated R&D strategy and structure, whereas the existing literature seems to combine them within a single construct. We nevertheless believe that our approach to R&D strategy and structure may provide valuable

opportunities for future research; for instance, the different types of R&D strategies (i.e., exploration and exploitation) and the unique relational capabilities required to implement them should be considered.

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APPENDIX A. Means, standard deviations (SD), parcel/item loadings.

Constructs and items (all measured on 7-point Likert scales, except the number of personnel and current ratios)	**Mean**	**SD**	**Loadings**	**Parcel**
Main variables				
Supplier R&D service offering in the customer relationship				
Product tailoring services	4.81	2.37	.51	
Feasibility studies	1.25	2.22	.77	
Research services	1.89	2.38	.85	
Problem analyses	2.26	2.45	.69	
Joint Learning				
Information sharing			.89	Parcel 1
Our companies exchange information related to changes in end-user needs, preferences and behavior.	5.11	1.49	.61	
Our companies exchange information related to changes in market structure, such as mergers, acquisitions or partnering.	4.13	1.69	.74	
Our companies exchange information related to changes in the technology of the focal products.	4.89	1.40	.77	
In the relationship, we frequently adjust our common understanding of end-user needs, preferences, and behavior.	4.73	1.76	.62	
In the relationship, we frequently adjust our common understanding of trends in technology related to our business.	3.89	1.73	.88	
Joint sense-making			.80	Parcel 2
It is common to establish joint teams to solve operational problems in the relationship.	3.21	1.83	.86	
It is common to establish joint teams to analyze and discuss strategic issues.	2.67	1.62	.87	
The atmosphere in the relationship stimulates productive discussion encompassing a variety of opinions.	4.43	1.61	.63	
Integration into a relationship-specific memory			.78	Parcel 3
In the relationship, we frequently evaluate and, if needed, adjust our routines in order delivery processes.	3.79	1.69	.91	
We frequently evaluate and, if needed, update the formal contracts in our relationship.	3.69	1.81	.81	
We frequently evaluate and, if needed, update information about the relationship stored in our electronic databases.	3.54	1.67	.87	
Supplier sales performance in the customer relationship				
Sales level in the relationship (importance of the measure * satisfaction in terms of the measure)	28.63	10.02	.65	
Sales growth in the relationship (importance of the measure * satisfaction in terms of the measure)	24.70	10.07	.75	
Control Variables				
Distance between the supplier factory and the customer (kilometers)	495.29	1130.37	-	
Customer dependency (supplier switching time for the customer measured in months)	9.74	10.34	-	