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Abstract

As in many organizations the role of the purchasing department is shifting from a clerical buying function to an internally integrated, strategic business function, purchasing professionals are increasingly involved in sourcing projects. Building on Social Exchange Theory, this study explores the effects of early purchasing involvement on internal customer satisfaction and cost savings in sourcing projects, as well as how this involvement is bounded by the strategic impact of the sourcing project. To this end, the authors gathered data on 644 sourcing projects from a database of a large, private financial services company. A research model deploying the research hypotheses was analyzed using Bayesian structural equation modeling. This technique introduced and highlighted as a valuable and more correct estimation procedure in hypothesis testing research involving ordered-categorical data. The results confirm that early purchasing involvement enhances the cost savings outcome in sourcing projects. However, this involvement has remained underutilized for projects with high strategic impact. This study empirically establishes the importance of purchasing professionals for realizing cost savings in sourcing projects.

Keywords

Early purchasing involvement; Cost savings; Bayesian structural equation modeling; Sourcing projects database; Case study

1 Introduction

During the past decade, (early) purchasing involvement has received increasing attention, especially in the context of new product development and innovation processes (Lakemond et al., 2001; Luzzini et al., 2015). One reason for this is the transition, or development process, of purchasing towards a more strategic and integrated business function in which it increasingly fulfills a role as manager of the supply base (Cousins et al., 2006; Úbeda et al., 2015). From its intermediary position, purchasing facilitates improvements in (product and process) quality, innovation and mobilization of supplier know-how (Luzzini et al., 2015). Besides purchasing's growing impact in terms of value creation, though, cost savings are still considered to be purchasing's primary contribution, especially in the context of the lagged effects of a recent global economic crisis, which saw firms pushing to reduce costs as much as possible (Hartmann et al., 2012). However, despite certain empirical studies demonstrating a positive impact of purchasing maturity on a firm's cost savings and financial performance (Foerstl et al., 2013; Schiele, 2007), descriptions of purchasing involvement's impact on cost savings appear to be merely conceptual and exploratory in nature (Ellram and Tate, 2015).

To address the increasing importance of purchasing involvement, as well as the limited existing empirical insights in regard to its cost-reducing impact, the authors undertake quantitative approaches to test the effect of purchasing involvement on cost savings. More specifically, because of the prominent impact purchasing can have, especially in the early phases of purchasing processes (Bals et al., 2009; Ellram et al., 2007), the authors seek insights into the impact of *early* involvement of purchasing professionals in sourcing processes. In doing so, the purchasing-internal customer relationship is considered, and more specifically, purchasing as an internal partner serving its internal customers. Along this line, early involvement of purchasers in the

purchasing decision process reflects the internal customer's belief in purchasing's added value and is driven by the internal customer's degree of trust in and openness toward purchasing (Bals et al., 2009; Barratt, 2004; Werr and Pemer, 2007). Thereby, the internal customer's trust often builds on previous successful experiences of purchasing involvement (Ellram and Tate, 2015). Hence, to secure their role in future sourcing projects, it is important for purchasing professionals to satisfy their internal customers. However, empirical research into such socially-desirable outcomes, stemming directly from purchasing involvement, appears to be limited. Moreover, insights into the role of social benefits (e.g., internal customer satisfaction) in the relationship between purchasing involvement and economic sourcing outcomes, such as cost savings, appear quite scarce. Similarly, further quantitative hypothesis testing research is required with regard to the determinants of purchasing involvement. Conceptual and exploratory studies often refer to organizational (e.g. department structure, position, company size) and (inter-) personal (e.g. skills, motivation, awareness, attitude, experience) aspects as influencing factors of purchasing involvement (Bals et al., 2009; Werr and Pemer, 2007; Wynstra et al., 2000). However, to a lesser extent, determinants are identified at the sourcing project level. For instance, a growing assumption that purchasing is increasingly involved in sourcing projects relating to more complex spend categories (Tate et al., 2010) requires further empirical testing.

Grounded in Social Exchange Theory (SET), the purpose of this empirical case study is to explore the effects of early purchasing involvement (EPI) on internal customer satisfaction (ICS) and cost savings in sourcing projects, as well as to verify to which extent this involvement is bounded by the degree of strategic impact of the sourcing project. With this focus, the paper addresses several substantial research questions: Does EPI impact on the cost savings outcome of the sourcing project? Moreover, is this effect mediated by the degree with which internal customers are satisfied by the purchasing professional's "entrepreneurial ability" demonstrated during the sourcing project? Finally, is EPI bounded by the level of strategic impact of the project?

This study is set up in the context of purchasing's development process, in which purchasing involvement, and serving internal customers well, are key (Sánchez-Rodríguez and Martínez-Lorente, 2004; van Weele, 2010), but for which quantitative hypothesis testing research is limited. More specifically, with this study, the authors respond to the rather conceptual and exploratory descriptions of purchasing's role in sourcing initiatives and processes, while contributing to the limited existing empirical insights into the impact of involving purchasing professionals, in terms of both social and economic sourcing outcomes (Bals et al., 2009; Luzzini et al., 2015).

In the next section, the authors elaborate on the constructs and theoretical background upon which the research model and hypotheses are built. After an explanation of the quantitative research design and method being utilized, the results of our hypothesis tests are presented. Finally, the authors conclude with the research findings, scholarly and managerial implications and suggestions for further research. In the Appendix, a research note is provided elaborating on the characteristics and advantages of the statistical analysis technique applied, i.e., Bayesian structural equation modeling.

2 Background and hypotheses

2.1 Theoretical background

In comparison to the rather large amount of literature on supplier involvement, research attention on purchasing involvement has remained limited in the purchasing and supply management (PSM) domain (Luzzini et al., 2015). This may be explained by the fact that in many, but mostly public, organizations, purchasing involvement is imposed and hence mandated. However, in the private sector, purchasing involvement is often dictated by the budget owners, referred to as internal customers in this study, who have full decision power (Ellram and Tate, 2015). Moreover, in light of purchasing's development process, namely, the transition of the purchasing function from a clerical and reactive buying function toward a strategic, internally integrated business function and (co-) manager of the supply base (Paulraj et al., 2006; Úbeda et al., 2015), the purchasing department is increasingly taking the lead in the firm's sourcing initiatives (Tate et al., 2010). Recently, more attention has been paid to the role of the purchasing department in facilitating value creation (Luzzini et al., 2015). For instance, purchasing professionals may reveal new opportunities in the external environment, enhance purchase quality and lead time or facilitate supplier involvement (Ellram et al., 2007; McGinnis and Vallopra, 1999; Schiele, 2005; Werr and Pemer, 2007). Along this line, researchers consider purchasing involvement a keystone of a mature purchasing organization (Schiele, 2007; Wolf, 2005) and a potential source of sustainable competitive advantage (Luzzini et al., 2015). However, despite purchasing's growing contribution in terms of value creation and supply risk reduction, a primary contribution of the purchasing department remains its cost savings capability (Hartmann et al., 2012; Úbeda et al., 2015). Regardless, quantitative hypothesis testing research specifically seeking to explore whether purchasing professionals contribute to cost savings outcomes in the context of sourcing processes, has remained scarce.

For this study, the authors investigate the earliness of purchasing involvement (EPI), pointing to the scope of purchasing involvement in the sourcing process. This examination builds on the fact that EPI depends on the budget owner's (internals customer's) trust and belief in purchasing's added value and therefore relates closely to the purchasing-internal customer relationship (Barratt, 2004; Ellram et al., 2007; Werr and Pemer, 2007). Moreover, the authors consider EPI as an incentive for purchasers to perform well, i.e., to meet or even exceed internal customer expectations, hence to satisfy internal customers (Jun and Cai, 2010).

In line with internal services literature, describing the internal customer service as a "twoway exchange process between individuals in different functional departments of a firm in which the provider is charged with responding to the needs of his/her internal customer, resulting in a satisfied internal exchange partner" (Marshall et al., 1998, p.382), the authors apply the tenets of Social Exchange Theory. This theory stresses the two-way character, as well as the interactional dynamics, of dyadic relationships (Miles, 2012). SET emphasizes that parties enter into an exchange because one expects that doing so will be rewarded in terms of either social (e.g., trust, social approval, respect) or economic (e.g., information, goods, services, assets) resources (Blau, 1964; Emerson, 1976). Should exchanges turn out to be rewarding for both parties, trust and commitment in the exchange relationship will increase (Emerson, 1976).

Applying SET, the authors consider purchasing involvement as a social resource received by the purchaser from a satisfied internal customer. In order to ensure their involvement in future projects, purchasing professionals must engage their internal customers by proving their added value, which is done by meeting internal customer needs (Ellram and Tate, 2015). Furthermore, the authors argue that internal customer satisfaction which, in this study, reflects the extent to which the internal customer is satisfied with purchasing's entrepreneurial ability as executed during the sourcing process, plays a mediating function between EPI and cost savings. In our view, ICS will stimulate the internal customer during the project to increase openness toward the purchasing professional involved. Finally, the authors include the strategic impact of the sourcing project as a potential boundary condition for EPI and investigate its implication with regard to cost savings, building on insights from purchasing portfolio management literature (e.g., Gelderman and van Weele, 2002). The resulting theoretical model is shown in Figure 1.

2.2 Research model and hypotheses

From a social exchange perspective, purchasing involvement can be considered a social resource received by the purchaser from the internal customer, reflecting the latter's belief and trust in purchasing's added value. Since the purchasing professional wants to be involved at an early stage of future projects as well current ones, the purchaser in question will have an increased incentive and motivation to deliver a high level of internal service quality (ISQ), enhancing the internal customer's satisfaction (Ellram and Tate, 2015; Jun and Cai, 2010). Indeed, in line with SET, the purchaser expects that satisfying the internal customer will be rewarded by, for instance, being involved at an early stage in future sourcing projects (Emerson, 1976). Furthermore, involving purchasing at an earlier stage often implies a closer internal customer interaction (Bals et al., 2009), yielding a timely and enhanced mutual understanding between purchasing (understanding the internal customer's needs) and the internal customer (understanding purchasing procedures; Rossler and Hirsz (1996)). Through this, purchasing gains insight soon in the internal customer's expectations with respect to the sourcing project through which communication, knowledge and information sharing (Ellegaard and Koch, 2012; Rossler and Hirsz, 1996; Werr and Pemer, 2007), and hence purchasing's internal service performance, improves (Fredendall et al., 2005). Combining the ideas that early involvement of purchasing enhances the purchasing professional's incentive to satisfy its internal customer, as well as the mutual understanding and cooperation between internal customer and purchaser driving the latter's ISQ, the authors state:

Hypothesis 1: Early purchasing involvement positively affects internal customer satisfaction

As stated, one can expect that if the internal customer is satisfied with how the purchasing professional manages the project during the sourcing process, the latter will be rewarded (Emerson, 1976). This SET-inspired perspective corresponds with ISQ literature, stating that ICS will favor the internal customer's perception of the purchasing department (Finn et al., 1996; Jun and Cai, 2010). During a sourcing project, this can be explained by an increase in openness and trust toward the purchasing professional involved (Carr and Smeltzer, 1997; Ellegaard and Koch, 2012; Finn et al., 1996), through which an opportunity arises for the purchasing professional to share his or her knowledge and cost-reducing expertise (Barratt, 2004; Ellegaard and Koch, 2012; Tate et al., 2010). In line with existing literature demonstrating a positive relationship between cross-functional integration and purchasing performance in terms of, among others, cost savings (Ellegaard and Koch, 2012; Hartmann et al., 2012; Werr and Pemer, 2007), the authors state:

Hypothesis 2: Internal customer satisfaction positively affects cost savings

In both managerial and academic PSM literature, the positive effect of purchasing's appropriate, and hence, in-time involvement into the organization's sourcing initiatives on both supply chain and firm performance, is clearly posited (Ellram et al., 2007; Glock and Hochrein, 2011; Schiele, 2005). More specifically, when purchasing is involved earlier in the sourcing process, and is thus able to seek contact and discussion with (potential) suppliers sooner, purchasing professionals may be able to steer the purchasing decision to a greater extent.

Purchasers may find themselves able to initiate earlier price discussions, or other commercial contract terms and conditions, with (potential) suppliers. As such, purchasing can even increase competitiveness among suppliers, motivating them to improve their commercial and service offerings (Tate et al., 2010). Based on the above statements, the fact that cost savings is, and remains, considered to be purchasing's primary objective (Hartmann et al., 2012; Schiele, 2007), and that our desire is to test whether mediation of ICS (in combination with Hypotheses 1 and 2) is full or partial, the authors state

Hypothesis 3: Early purchasing involvement positively affects cost savings

Aware of the potential benefit of involving purchasing professionals early in the sourcing process, the authors expect, however, that internal customers will not appeal to purchasing's expertise in the same way for all of their sourcing projects. More specifically, we assert that EPI will come to play specifically for those sourcing projects with high strategic impact. Past studies on purchasing involvement indicate that, especially for purchases with high strategic value and risk for the internal customer and/or representing high dollar value, the role of purchasing starts in the early phases of the sourcing process, i.e., the development of a statement of work and market research (e.g., Ellram and Tate, 2015). Analogously, research on purchasing portfolio management signifies that purchases of non-critical items, which correspond with low strategic impact, are associated with a sourcing strategy on efficient and transaction-oriented purchasing processes with quick decision-making (Gelderman and van Weele, 2002). Thereby, the internal customers are mainly interested in the availability of an accurate operational purchasing system or a quick delivery of the right products/services selected that were ordered by themselves. As such, no early

purchasing input in the sourcing process in terms of market research and product specifications is required by the internal customer. On the contrary, purchases of strategic items, characterized by a high level of profit impact and supply risk and thus a high level of strategic impact, require a proper use of the company's funds, and more management of the purchase decision by involvement of individuals with purchasing expertise (Glock and Hochrein, 2011; Johnston and Bonoma, 1981). Therefore, the authors hypothesize that EPI is bounded by the condition of strategic impact, and is especially limited when strategic impact of the sourcing project is low:

Hypothesis 4: The strategic impact of the sourcing project positively affects early purchasing involvement

Besides the expectation that purchasers will be involved earlier in sourcing projects with high strategic impact, the authors also assume that EPI will positively mediate the relationship between strategic impact and cost savings. Similar to the theoretical support of Hypothesis 3, the authors assert that, as purchasing is involved earlier in the sourcing process, it tends to enjoy more "latitude" to enable discussions on prices and other commercial contract terms and conditions with (potential) suppliers (Tate et al., 2010). Based on the above statements, and our desire to test whether mediation of EPI is full or partial, the authors hypothesize a direct positive effect of strategic impact on cost savings. The latter is supported by literature on category management and sourcing strategies, stating that, for strategic rather than for non-critical items, a single-sourcing strategy is used (Faes and Matthyssens, 2009). This sourcing strategy has been recognized as the preferable strategy to realize cost reduction (Buttack, 2001; Ellram and Billington, 2001; Larson and Kulchitsky, 1998). The authors therefore state:

Hypothesis 5: Strategic impact of the sourcing project positively affects cost savings



Figure 1: Research model and Hypotheses

3 Research methods

3.1 Research design and data collection

Hypothesized relationships were tested through an empirical case study, using the extensive sourcing projects database of a large financial institution, referred to in this study as "Alpha". The company, a leader in the Dutch financial services industry, has systematically collected and stored multiple data about all of its sourcing projects over the past 15 years.

Alpha's annual average purchasing expenditures exceed two billion euros, mostly in the form of indirect spend, and its purchasing-turnover ratio of 60% has been stable for the last few years. The purchasing department maintains a center-led and category-driven purchasing structure, with the internal customers – and not the purchasing department – serving as the actual contract

and budget owners within the company, and they have full decision power on whether, and when, to involve purchasers. Purchasing professionals are utilized to serve as "consultants" to the business for the tactical purchasing process, i.e., from market orientation and analysis through contracting (referred to as the "sourcing process" in this study). Payment orders are implemented by the internal customers using the electronic purchasing system solutions provided and supported by a separate division of the purchasing department, a structure which is outside the scope of this study. In general, one purchasing professional is involved in each sourcing project at Alpha.

The primary data for the current study are derived from the company's sourcing projects database, which differs from traditional data sources such as a single respondent self-administered cross-sectional questionnaire (van Weele and Van Raaij, 2014). Full insight into Alpha's data collection process and the characteristics of the sourcing data was gained through the following activities:

1) In-depth interviews with Alpha's chief purchasing officer, sourcing database experts and category managers, who use the database on a daily basis, and two internal customer managers;

2) Analysis of secondary data about Alpha's purchasing structure (documents on e.g., purchasing strategy, structure and processes) and database (e.g., database manual, reporting presentations);

3) Collaboration with one of Alpha's database experts, providing the authors with supportive firsthand information.

3.2 Variable operationalization

The company used single item measurement scales for the operationalization of the variables EPI and cost savings, as these were considered *observable* constructs (Rossiter, 2002). In line with van Weele and Van Raaij (2014), single items may be preferred over multi-item constructs. For ICS, on the other hand, which contains subjective information (i.e., an opinion), a latent variable with three indicators was used. Data on strategic impact were derived directly from qualitative sourcing project information in the database, i.e., Alpha's positioning of the sourcing project in the Kraljic (1983) matrix.

Early purchasing involvement (or earliness of purchasing involvement) refers to the moment, or sourcing stage, at which the purchasing department has become involved in the sourcing process, and hence reflects the scope of involvement (step model, van Weele, 2010). It relates to purchasing's role and internal integration within the organization, which are critical parameters in purchasing development models (Ellram and Carr, 1994; van Weele, 2010; Werr and Pemer, 2007). Alpha's sourcing process actually contains five sequential stages: (1) market orientation, (2) specifications definition, (3) supplier selection, (4) negotiation and (5) contracting. The authors used Alpha's reverse-coded, single-item, ordinal scale to operationalize the earliness of purchasing involvement, with usage of an ordinal scale to measure the involvement level corresponding with other empirical research on, for instance, early supplier involvement (e.g., Walter, 2003).

Internal customer satisfaction refers to the degree with which internal customers are satisfied with the dedicative and entrepreneurial competence employed by the purchasing professional involved in the sourcing project being examined. Alpha used an ordinal scale (1:

totally dissatisfied – 10: totally satisfied) to ascertain the opinion of the internal customer on the purchasing professional's competence during the project, with respect to (1) working in an internal customer-oriented way (ICS_{cust}), (2) undertaking action/being entrepreneurial (ICS_{entr}) and (3) taking initiative (ICS_{init}). The scores given by the internal customer were put directly into the sourcing project file in the database. Past research on ISQ has proven the validity and performance of perceptions-only measurement approaches (Brandon-Jones and Silvestro, 2010).

Cost savings utilizes a continuous scale representing the proportion of savings realized within the sourcing project as an objective measure of purchasing performance, calculated by setting out the absolute (actual) savings against the absolute original purchase cost (i.e., the sum of actual purchase expenditures and actual savings). Data on the actual purchase spend and savings per project were gathered from the database. Given the research context (i.e., a high proportion of indirect spend and its large impact on the firm's bottom line), cost savings was the primary objective of Alpha's purchasing department during the period in question. In recent PSM research, cost savings is still recognized as the primary contribution of the purchasing department (Hartmann et al., 2012).

Strategic impact relates to the supply risk and profit impact of the sourcing project. The measure used is derived from the position of the sourced item in the purchasing portfolio. For each project, the position in the widely-accepted Kraljic (1983) matrix was provided by Alpha and verified by the company's category managers. Strategic impact increases with the dimensions of the Kraljic matrix, namely profit impact and supply risk, and ranges from one to three: A value of 1 indicated a non-critical item, 2 signified a bottleneck or leverage item (high on one Kraljic matrix dimension) and 3 signaled sourcing for strategic items (high on both Kraljic matrix dimensions).

3.3 Data analysis

The initial sample concerned 901 finalized sourcing projects entered in Alpha's database between the years 2005 and 2012. Due to certain additional insights on data reliability and validity being garnered, the authors decided to omit 113 sourcing projects of the dataset from further data analysis. In addition, we only selected sourcing projects in which *new* supplier contracts were negotiated. The reasoning behind this is that the authors determined that, for projects involving contract extensions and renewals, 1) it is common that not all sourcing steps actually take place (i.e., only a new negotiation round with the current supplier was organized after which the contract with similar terms and conditions was closed) and 2) the savings potential would be substantially lower. Exploratory research in our database confirmed this assumption, and so 144 additional cases were left out of further analysis. As a consequence, the final dataset that was actually used contained 644 sourcing projects from various purchasing categories. Table 1 provides insight into data characteristics with respect to the research constructs and measures.

Frequency (in proportion to the entire sample)						Loading
EPI	(1) 44%	(2) 13.9%	(3)11.5%	(4) 26.8%	(5) 3.8%	
ICS customer-oriented	(5-6-7) 13.9%	(8) 61.2%	(9-10) 24.9%			0.85
ICS initiative	(5-6-7) 27%	(8) 52.6%	(9-10) 20.4%			0.76
ICS entrepreneurial	(6-7) 23.7%	(8) 57.2%	(9-10) 19.1%			0.93
Strategic impact	(1) 20.4%	(2) 61%	(3) 18.6%			
	Min	Max	Mean	S.D.		·
Cost savings	0.00	0.98	0.19	0.18		

 Table 1: Descriptive statistics and factor loadings of the indicators

Notes: EPI: early purchasing involvement; ICS: internal customer satisfaction; numbers in brackets represent the ordinal category values; S.D.: standard deviation

A multivariate, second-generation estimation technique was required to generate unbiased estimates and to facilitate considerations of latent and indicator variables (Hair et al., 2010). The authors chose Bayesian structural equation modeling for the following reasons: First, structural equation modeling (SEM) is a widely accepted and frequently employed tool in psychological and social sciences for research hypothesis testing (Lee et al., 2007). It has been proven to be a powerful multivariate tool to test, confirm or compare theories (Song and Lee, 2012), since it combines a test of the structural model, wherein multiple dependence relationships can be analyzed simultaneously, with a test of the measurement model used, i.e., confirmatory factor analysis (Bagozzi and Yi, 2012). It therefore allows researchers to test cause-effect relationships with latent variables (Hair et al., 2010). Second, we chose Bayesian estimation in covariancebased SEM (further CB-SEM), instead of the in organizational research traditionally employed Maximum Likelihood estimation (MLE) procedure (Lee and Song, 2004). An important assumption of the latter estimation approach is multivariate normality within the data distribution. However, a great deal of CB-SEM applications over the past two decades are based on orderedcategorical data (e.g., Likert scales) for which this assumption cannot hold (Bulmer, 2012; Tucker, 1962). Although it has become a widespread practice to treat these ordinal data as if these were continuously scaled (Byrne, 2010), failure to address the ordinal nature of data might, however, lead to biased research conclusions (DiStefano, 2002). One way to address the ordinal nature of empirical data in SEM analysis is to employ the Bayesian estimation approach instead of the traditional frequentist methods, such as MLE.

In addition to consideration of the ordinal nature of data, Bayesian estimation provides researchers with two more advantages: First, it provides more, and more precise, information on the estimated model parameters (i.e., information on the parameters' joint probability distribution) in comparison to traditional estimation procedures in CB-SEM. Moreover, it allows researchers to incorporate prior distribution information to estimate these parameter distributions, specifically, posterior distributions (Song and Lee, 2012). Second, previous research has proven that Bayesian

estimation results are more precise and reliable in estimating SEMs in cases featuring relatively small sample sizes (Lee and Song, 2004).

Despite recent attention for Bayesian statistics in empirical management research (e.g., Jebb and Woo, 2015; Zyphur and Oswald, 2013), insight into, and understanding of, this estimation approach seems rather limited, with application in empirical purchasing research being scarce. The research note in Appendix provides more details on the characteristics and advantages of Bayesian SEM.

For this study, the authors analyzed data using the Bayesian estimation procedure in AMOS 22. This software program uses the Bayesian approach as a default method to analyze categorical data (Byrne, 2010).

4 Results

4.1 Measurement model

In evaluating measurement model fit, Bayesian estimation provides the posterior predictive value as general goodness-of-fit measure (Scheines et al., 1999). Bayesian estimation offers additional model fit measures in cases where all variables in the model are interval scaled. The posterior predictive value in our example was 0.52, indicating very good model fit. Construct validity of ICS was assessed by means of a confirmatory factor analysis, so all single indicators of the other constructs in the structural model were included (Brown, 2015). Convergent validity of ICS was proven, since all standardized loadings of our ICS indicators (see Table 1) exceeded the threshold of 0.707, proving indicator reliability, and were significant at 0.05 level (Hair et al., 2010). In addition, loadings were below 1.0 and no negative error variances were found. The

authors then computed the Average Variance Extracted (AVE) from the AMOS output. Note that the authors actually computed the posterior distribution of AVE, as evidenced in Figure 2. The mean posterior value of AVE was 0.72, which should be higher than 0.5 to indicate convergent validity (Hair et al., 2010).



Figure 2: Posterior distribution of Average Variance Extracted of Internal customer satisfaction

As frequentist reliability and validity measures, such as composite reliability and Cronbach's Alpha, are based on multivariate normality, they cannot be calculated for ordinal variables. The authors assessed discriminant validity using the Fornell-Larcker criterion (Fornell and Larcker, 1981; Hair et al., 2010). It compares the square root of the AVE values with the latent variable correlations. Specifically, the square root of each construct's AVE should be greater than its highest correlation with any other construct. From the Bayesian estimation procedure, the authors have posterior distributions of the covariances and variances of all the variables in the utilized measurement model, and from these, correlations were computed. In Table 2, the posterior means of the correlations and the square root of AVE for ICS are shown. Since the correlations were much smaller than the square root of AVE (0.85), discriminant validity is proven.

Table 2: Discriminant validity

	Internal customer	Early purchasing	Cost	Strategic
	satisfaction	involvement	savings	impact
Internal customer satisfaction	0.85			
Early purchasing involvement	-0.03	1		
Cost savings	0.07	-0.16	1	
Strategic impact	-0.15	0.21	0.21	1

Notes: Diagonal elements in bold represent the square root of Average Variance Extracted; off-diagonal elements represent the posterior means of the correlations

4.2 Structural model

To evaluate the structural model, the SEM model was fitted to the data using AMOS. By default, AMOS uses uniform non-informative priors, which the authors kept unchanged. The posterior predictive value of the estimated model is 0.5, suggesting a good model fit (Scheines et al., 1999). Support was found for hypotheses 3 and 5, while Hypothesis 4 was contradicted and hypotheses 1 and 2 were not supported. Table 3 shows the structural parameters with their associated confidence intervals.

	Mean	95% C.I. low	95% C.I. up
Direct effects			
Early purchasing involvement \rightarrow Cost savings Early purchasing involvement \rightarrow Internal customer	-0.206	-0.360	-0.051
satisfaction	-0.053	-0.270	0.167
Internal customer satisfaction \rightarrow Cost savings	0.090	-0.039	0.217
Strategic impact \rightarrow Cost savings	0.261	0.141	0.380
Strategic impact \rightarrow Early purchasing involvement	0.204	0.047	0.367
Indirect effects			
Strategic impact \rightarrow Cost savings	-0.043	-0.03	-0.001
Early purchasing involvement \rightarrow Cost savings	-0.004	-0.006	0.004

Notes: C.I.: Confidence interval; note that Early purchasing involvement is reverse-coded

Unfortunately, AMOS does not compute multiple correlations (R^2 values) in the Bayesian estimation. Multiple correlations or coefficients of determination are defined as 1-(variance error)/(variance observed variable). The Bayesian posterior mean of the variance of the observed

variable is not computed by AMOS for the structural model. However, the authors do have these values from the measurement model, and plugging these variances into the formula, the authors found for EPI, ICS and cost savings an R^2 of, respectively, 0.09, 0.05 and 0.11. Even though these values indicate that the determinants in the model only weakly explain the variance in our endogenous constructs, interpretation should be done in light of our research context.

The authors did not find support for Hypothesis 1, stating that EPI positively affects ICS. For the parameter for the regression of ICS on EPI, we found a posterior confidence interval of -0.26 to 0.16. Since the value zero lies within the confidence interval, the authors did not find support for the research hypothesis (at 0.05 level). Also from the graphical representation of the posterior distribution in Figure 3, one sees that the null hypothesis, whereby this parameter equals zero, could not be rejected. A reminder here that this parameter, and hence its posterior distribution, refers to the underlying continuously scaled variable and not directly to the ordinal scaled measures of EPI and ICS.





The relevant regression parameter for hypothesis 2, i.e., ICS positively affects cost savings, had a posterior confidence interval between -0.01 and 0.04. Therefore, the effect was not significant.

For Hypothesis 3, which posits that EPI positively affects cost savings, the posterior confidence interval for the regression parameter was between -0.07 and -0.01, significantly lower than zero. Note that, since EPI is reverse-coded, this implies a positive effect, as stipulated by our hypothesis. For the standardized direct effect, we found a posterior mean of -0.21. The significance of this is also illustrated in the plot of the posterior distribution of the standardized direct effect (see Figure 4).

Figure 4: Posterior distribution from the standardized direct effect of Early purchasing involvement (EPI) on Cost savings



For Hypothesis 4, which states that strategic impact positively affects EPI, the posterior confidence interval was between 0.08 and 0.65, a result significantly larger than zero. The mean posterior value of the standardized direct effect is 0.2, and since EPI is reverse-coded, we need to interpret this effect as negative, which contradicts the formulated hypothesis.

Finally, support was found for Hypothesis 5, which holds that strategic impact positively affects cost savings. For the (direct) regression of cost savings on strategic impact we found a posterior confidence interval between 0.04 and 0.12. Therefore, we conclude that this direct effect was significantly positive. Since we also found significant effects from strategic impact on EPI (Hypothesis 4) and from EPI on cost savings (Hypothesis 3), we also saw a significant indirect effect on cost savings. The posterior means of the standardized direct effect and standardized indirect effect were 0.26 and -0.04, respectively, with the latter being illustrated by the plot in Figure 5. Note that this posterior distribution is heavily skewed, which indicates non-normality of the underlying parameter of the indirect effect, as explained in the Appendix. Hence, using a Bayesian approach here was necessary as the normality assumption in MLE could not hold.





The final model is summarized in Figure 6, wherein the numerical values represent posterior means of the standardized estimates. In addition, a "*" indicates significance of the effect or loading.

Figure 6: Results of the hypothesis testing and loadings of internal customer satisfaction



Notes: Standardized values; note that early purchasing involvement is reverse-coded; * indicates significance at 0.05 level; ICS: Internal customer satisfaction; cust: customer oriented, init: initiative, entr: entrepreneurial

5 Discussion and conclusions

The objective of this study is to empirically investigate the impact of EPI on cost savings within sourcing projects, whereby we hypothesize that this effect is mediated by ICS. In addition, we investigate whether EPI is bounded by the level of strategic impact of the sourcing project. Research hypotheses are grounded in SET and literature on purchasing category management and tested by means of Bayesian SEM, and the authors find a good fit of our model to a dataset of 644 sourcing projects of mainly indirect spend within one large financial services company, referred to as Alpha.

A first empirical, and important, finding of our study is that EPI enhances the cost savings result in sourcing projects. It confirms earlier research on purchasing's involvement and contribution (Ellram and Tate, 2015; Hartmann et al., 2012) and contradicts managerial arguments

on restricting (early) purchasing involvement in sourcing projects. However, the postulated interrelationship between EPI, ICS and cost savings is not confirmed, with only insignificant effects of EPI on ICS, and of ICS on cost savings, being found. In our opinion, these results can be explained by the following: Firstly, ICS in the current study is about the level of satisfaction with purchasing's competences in taking initiative, demonstrating an entrepreneurial attitude and working in a customer-oriented way, as described in section 3.2. With respect to purchasing performance, we only considered cost savings as a possible sourcing outcome. However, in light of the purchasing development process, purchasing's contribution goes beyond cost savings, by also representing the improvement of quality, the openness to innovation and the mobilization of supplier knowhow - the so-called value creation contribution of purchasing - along with the management of supplier performance and supply continuity, and thereby managing supply risk (Krause et al., 2001; Narasimhan and Das, 2001; Úbeda et al., 2015; van Weele, 2010). A possible explanation for our research results in this respect is that the competences incorporated into our ICS construct will be required by the internal customer, and exhibited by the purchasing professional, to a greater extent in those sourcing projects where value creation and risk reduction are relatively more important than cost savings. Secondly, our results may be caused by the data being employed. In Table 1, we observe that variation in data of the ICS indicators is rather low, and during our in-depth interviews at Alpha, we observed a company culture characterized by a certain (internal) politeness. Based on these facts, we can assume that internal customers will not proportionally have given lower scores for projects where purchasing performance was worse, and hence, the actual ICS was in fact lower. As a consequence, significant effects were harder to find, so further research is required to explain these research findings.

Another important research finding relates to the fact that cost savings are higher for projects with higher strategic impact, confirming preceding conceptual and exploratory research (e.g., Ellram and Tate, 2015), and using this logic, the authors expected earlier involvement of purchasing in these projects. This expectation is contradicted by the research results. Internal customers at Alpha have been rather reluctant to involve purchasing professionals early when strategic impact of the sourcing project was high, a finding that can be explained by a lack of trust or belief of internal customers in purchasing's added value (Bals et al., 2009; Werr and Pemer, 2007). For instance, internal customers may take a defensive attitude, perhaps relying on their own technical and business expertise to ensure the desired value creation and risk reduction outcomes. Another explanation may relate to a perceived misalignment of (strategic) priorities between the purchasing and internal customer department (Tate et al., 2010), and internal customers may also be unaware of the cost savings potential through EPI. This research outcome calls for further empirical investigation and stimulates formulation of new, additional hypotheses which could not be tested in the current study.

5.1 Theoretical implications

The present research is valuable from a theoretical point of view. First, it adds to PSM literature on the involvement and contribution of the purchasing department in the context of sourcing processes, providing evidence on the impact of EPI in regards to cost reduction outcomes in sourcing projects. In fact, the current study is the first, to the best of our knowledge, that quantitatively examines the construct relationships considered. The research findings defend preceding statements on the importance of EPI in sourcing processes (e.g., Ellram and Tate, 2015).

Second, research findings demonstrate that internal customers are rather reluctant to involve purchasing professionals at an early phase when strategic impact of the project is high. This finding contradicts the respective postulated hypothesis. Although the authors can explain this result from a managerial perspective, as described above, it has not been addressed by theory and therefore represents an important theoretical implication of this study.

Third, although hypothesized relationships with ICS were not confirmed, the authors approach the purchasing-internal customer relationship from a social exchange perspective, which is a valuable but under-researched theoretical perspective in the PSM research domains of purchasing involvement and ISQ. Finally, the gathered data originated from a financial services firm, which adds to the limited academic knowledge on PSM gained from, and about, services companies (Tate et al., 2010).

5.2 Methodological contributions

The study also contains some methodological contributions to purchasing research. First, this article introduces and employs Bayesian statistics as a novel method in analyzing a structural equation model in PSM research. Bayesian SEM allows researchers to account for the ordinal nature of their variables. In addition, as highlighted, it provides more, and more precise, information on the model parameter estimates and their distributions, while performing better when sample sizes are relatively small, in comparison to frequentist methods such as MLE. Although the method has received some attention in supply chain management (SCM) research in the past, Bayesian statistics has not yet been acknowledged in PSM research as a means to estimate SEMs. The authors recommend that PSM researchers use Bayesian estimation in SEM research as soon as the data being employed are ordered-categorical, if only to verify research

results from traditionally used procedures such as MLE, with the aim of making research findings more robust. Nevertheless, the authors would like to note that there are some limitations in the AMOS implementation, as mentioned earlier, such as AMOS not providing multiple correlations (R^2 values) in the Bayesian option. Also, especially within the context of ordinal variables, only the posterior predictive p variable is available for the assessment of goodness of fit. This is mainly because most of the measures used for model fit assessment or model comparison depend in some way on multivariate normality, and hence cannot be used directly (Lee, 2007).

Second, the authors relied on data which were directly derived from a company's sourcing database, containing valuable and in-depth information on each of the company's sourcing projects. As such, "at hand" company sourcing data was used. The authors hope that this illustration will stimulate PSM researchers to find, and rely on, new data sources in order to overcome the limitations (for instance, in theory testing) of traditional data sources, such as the cross-sectional survey (Dul and Hak, 2008; van Weele and Van Raaij, 2014), and to bring academia and practice closer to each other.

Third, the authors studied the construct relationships at the sourcing project level, which differs from the traditionally-explored function or firm level in empirical research on purchasing development and performance (e.g., Hartmann et al., 2012; Paulraj et al., 2006; Schiele, 2007). Fourth, given the good measurement model statistics, our three components of ICS can be further extended as an original approach and measure of internal customer satisfaction. The measure can be interesting as well for purchasing and supply managers from an internal marketing perspective. Below is a discussion on the main implications for practitioners.

5.3 Managerial implications

For practitioners, this study is important since (early) purchasing involvement is not obvious in a great deal of organizations. Internal customers are often reluctant to involve purchasing professionals in their sourcing projects, because they are not aware of the potential benefits, do not believe in purchasing's added value, or consider purchasing involvement as a loss of control (Bals et al., 2009). By proving the positive impact of EPI on cost savings, the authors complement the years-long struggle of the purchasing department to "earn" its role in sourcing processes. Purchasing and supply managers can benefit from this study in claiming their complementary role, next to the internal customer, in strategic sourcing projects (Tate et al., 2010). Research findings may even trigger organizational and sourcing management to implement an EPI standard for sourcing processes.

However, this study also points out a potential problem for purchasing managers. Our study shows that internal customers were reluctant to involve purchasing professionals in sourcing projects with high strategic impact. Although further research is required to investigate the internal customers' motives in this respect, it is a major barrier to purchasing using and applying its expertise in the firm's sourcing initiatives, and may even limit further development of the purchasing department in the organization. If purchasing desires to become involved in the early stages of sourcing projects with high strategic impact, instead of simply being left out, it will need to prove its added value in the early phases, such as in market research and specification definition, to the internal customer. Therefore, purchasing needs the right service attitude and competencies, including business affinity, supply market and business knowledge, research and analytical skills.

5.4 Limitations and further research

Finally, the authors feel that the research findings that have been presented are subject to limitations wherefrom avenues for further research can be derived.

Interpretation of our research findings should be carried out by taking the research context and design into account, namely, an empirical study of one case company. Generalization of the research findings is therefore somewhat restricted. Additionally, the authors employed a company database and therefore faced restrictions in terms of available and reliable data, which affected research variables and hypotheses. For instance, with respect to purchasing involvement, only the scope of involvement was considered. Additional data on the role of purchasing involvement within the sourcing project, such as the *depth* of purchasing involvement (e.g., degree of responsibility and ad hoc versus full coordination), would have strengthened our research (Ellram and Tate, 2015; Lakemond et al., 2001). Similarly, the authors have only focused on the cost reduction outcome of sourcing projects. Despite the cost reducing pressure of the economic crisis and (thereby) Alpha's strong focus on purchasing's cost savings objective in the period under examination, today's purchasing's contribution increasingly involves other (non-financial) outcomes as well, such as quality improvement, innovation and supply risk reduction (Hartmann et al., 2012; Úbeda et al., 2015). In this regard, the authors also looked into the cost savings realized in the sourcing project, ignoring potential added costs of the operational buying process that were related to quality, delivery or services issues. Also, it is worth noting that ICS data reflect the internal customer's opinion provided at one undefined point of time during the sourcing process.

Furthermore, the authors maintained a purchasing department focus to explain the sourcing project outcome. However, characteristics of the cross-functional sourcing team (e.g., teamwork

quality, team effectiveness) and individual purchasing professional (e.g., expertise, skills, experience) may have partially affected the sourcing project outcome as well (Driedonks et al., 2014; Wynstra et al., 2000).

Next, a multi-year sample was employed. Although exploratory research of our data did not indicate patterns over time, research findings were not explicitly controlled for trends in the data over time. For instance, from an SET perspective one can expect that relationships between certain purchasers and internal customers may become reinforced over time as trust and commitment grows, with these purchasers perhaps becoming involved earlier over the course of time. Similarly, contextual changes (e.g., economic crisis, inflation) within the time period under consideration may have influenced the cost savings outcomes of the sourcing projects.

In addition, the authors did not incorporate initial sourcing project intentions or project type differences (e.g., goods vs services, types of internal customer (needs), types of services) as control variables into the model in this study, although little is known on how purchasing involvement differs among these characteristics of sourcing projects in academic PSM literature (Ellram and Tate, 2015). Along this line, further research would also benefit from testing the construct relationships with a sample containing projects of both direct and indirect spend, with the objective of seeking to verify whether purchasing involvement depends on the type of spend.

Furthermore, no reverse relationships have been included, since project data were not longitudinal. A study with longitudinal data would be a valuable extension to the current case study as it would facilitate the empirical testing of the exchange character in the purchasinginternal customer relationships, as well as the latter's dynamics through the reciprocal rewarding process, as depicted by SET (Emerson, 1976; Homans, 1958). Finally, in relation to our theoretical lens, the authors must mention that, despite being recently recognized in the PSM field as relevant theory to study supply chain relationships (Spina et al., 2016), SET actually originates from studying interpersonal exchanges instead of department exchanges. Although this theory's unit of analysis of personal interactions is followed in this study, the authors build on the assumption that norms and attitudes held by members of a certain group, in this case a department, are group-related, in line with the cognitive and normative orientations of group members toward others as depicted by Lawrence and Lorsch (1967). One should also consider the fact that, on average, only one purchasing professional was involved per sourcing project, interacting with a single internal customer manager, leading the authors to conclude that interpersonal exchanges are most assuredly being studied.

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Appendix: Research note on Bayesian structural equation modeling involving ordinal variables

Despite the widespread use of ordered-categorical data (Hinkin, 1995) and the availability of Bayesian estimation for SEM purposes in some popular data analysis software packages, such as AMOS (Byrne, 2010), the application of Bayesian estimation has actually been rare in empirical organizational science (Kruschke et al., 2012) and SCM research (Jebb and Woo, 2015; Rungtusanatham et al., 2014). In fact, usage of Bayesian statistics in PSM research has generally been restricted to simulation studies (Olson and Wu, 2011), with its utilization in the context of

structural equation models being very infrequent. In light of 1) the increasing use of SEM in the PSM and broader SCM research field (Riedl et al., 2014) and 2) the common practice in empirical management and organizational research of using ordered-categorical data, this issue requires further attention. With this being noted, the authors did not intend to enter into the ongoing literature-based debate on the practice of considering ordinal data to be continuously scaled, or the discussion on frequentist versus Bayesian inferences. Nevertheless, the authors do aim to introduce and highlight the characteristics and advantages of Bayesian estimation as a valuable procedure in analyzing ordered-categorical, non-normally distributed data with SEM.

Whereas MLE calculates fixed model parameters (such as p-values), in Bayesian estimation, variables and model parameters are unknown and regarded as random variables involving a joint probability distribution. Starting out from a so-called *prior distribution*, an iterative simulation-based algorithm called Gibbs sampling, using Markov Chain Monte Carlo (MCMC) methods, is used to obtain *posterior distributions* (Bolstad, 2007). The mean of the marginal posterior distribution, called the *posterior mean*, is generally reported as a parameter estimate. Using the marginal posterior distribution, it is also possible to compute a 95% confidence interval, the so-called highest density interval or HDI, on the parameter of interest (Kruschke et al., 2012).

Ordinal data

Traditionally, MLE is used to estimate unknown parameters in SEM. This estimation procedure assumes multivariate normal data distribution that, in turn, defines the (log)likelihood function (Lee and Song, 2004). The standing assumption of a multivariate normal distribution allows for testing hypotheses using familiar chi-squared tests. However, in many survey studies, the data involved is ordinal in nature (Holgado–Tello et al., 2010), which is unfortunate, since the assumption of a multivariate normal distribution cannot hold (Bulmer, 2012; Tucker, 1962). As a possible solution, *polychoric correlations* are often used (Savalei, 2011), defined as estimates of correlations of unobserved multivariate normally distributed variables that are assumed to have generated observed ordinal scaled variables. As a consequence, the use of polychoric correlations in the estimation of SEM is equivalent to the usual MLE on the unobserved underlying multivariate normally distributed variables (Holgado–Tello et al., 2010). For a single ordinal variable, the existence of a normally distributed underlying variable with zero mean and unit variance is inconsequential. In a recent simulation study by Kampen and Weeren (2015), however, it is shown that this assumption is usually questionable in a multivariate setting for typical survey data, so the use of polychoric correlations with realistic survey data is usually not quite appropriate either.

In Bayesian estimation, the assumption of underlying normally distributed data is still used cf. polychoric correlations. However, since the authors actually estimate the distributions of the parameters, the Bayesian approach is more robust in regards to the distributional assumptions. More specifically, when the posterior distribution is not normal, the confidence interval gained from Bayesian estimation is far more reliable than a traditional confidence interval (Lee and Song, 2004). Hence, Bayesian estimation is recommended under the condition of non-normally distributed data.

Precise distribution information

MLE provides fixed-parameter values based on the data at hand. In contrast, Bayesian estimation provides the ability to combine these data with prior distribution knowledge to estimate

more precise estimation parameters, i.e., their posterior distributions (Kruschke et al., 2012; Song and Lee, 2012). Using these posterior distributions, accurate confidence intervals of 95% can be obtained. As mentioned above, these are usually more reliable than the confidence intervals obtained from MLE, since they do not rely on distributional assumptions (Song and Lee, 2012). Thus, especially in the case of non-normality, these confidence intervals are to be preferred. Another advantage of Bayesian estimates is that they allow for graphical inspection of the posterior distributions, which provide more insight than the confidence intervals alone. For example, in Figure 5 there is a graphical representation of the posterior distribution of an indirect effect, and the authors conclude two things: First, that the parameter is significant, since zero is in its right tail. Second, that its distribution is heavily skewed, thus illustrating non-normality of the underlying parameter of the indirect effect. This shows that using a Bayesian approach here is necessary as the normality assumption in MLE cannot hold.

Furthermore, with a view to a recent research call on the importance of sufficient statistical power and reporting on the statistical power of SEMs in SCM research (Riedl et al., 2014), Kruschke et al. (2012) argue that the Bayesian approach provides precise power estimation from the complete distribution of the parameter values.

Small sample size

Previous research has shown that the Bayesian approach should be preferred over MLE with cases involving small sample sizes (i.e., two or three times the number of unknown parameters), regardless the data distribution, and that it is resistant to model complexity (Lee and Song, 2004; Scheines et al., 1999). Since the traditional tests derived from MLE largely depend on asymptotic distributions, larger sample sizes are needed (Amemiya, 1985; Bulmer, 2012).

However, Bayesian estimation does not depend on asymptotic results and, as a result, the requirement of larger sample sizes does not apply in the Bayesian context (Song and Lee, 2012).

Although the authors do not intend to provide critical analysis of MLE in favor of Bayesian estimation, Table A-1 provides an overview of the key attributes and assumptions of both approaches with respect to SEM.

Table A-1: Key attributes and assumptions of Maximum Likelihood and Bayesian estimation in SEM, based on extant literature

Issue	Maximum Likelihood CB-SEM	Bayesian SEM
Inference type	Frequentist	Bayesian
Estimation/parameters	Fixed model parameters	Random variables, joint probability distribution
Estimation procedure	Parametric	Non-parametric
Data distribution	Multivariate normality	No multivariate normality required
Sample size	Large sample size required	No sample size restrictions (small/large)
Estimation of complex models	Often difficult to calculate model parameters for complex models with smaller sample size	Flexible estimation of both linear as well as non-linear hierarchical models, regardless of (unbalanced; small) sample size
Scale	At least interval-scaled (to meet normality assumption)	At least ordinal-scaled; can handle mixed continuous and discrete variables
Data input	Covariance matrix of data at hand	Raw observations Possibility of incorporating prior knowledge (prior distribution) into the estimation of parameters

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