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Tobias Schoenherr[a]; Vincent A. Mabert[b]
[a] Department of Supply Chain Management, The Eli Broad Graduate School of Management, Michigan State University, East Lansing, MI 48824, USA [b] Operations and Decision Technologies Department, Kelley School of Business, Indiana University, Bloomington, IN 47405, USA

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A comparison of online and offline procurement in B2B markets: results from a large-scale survey

Tobias Schoenherr[a]* and Vincent A. Mabert[b]

[a]*Department of Supply Chain Management, The Eli Broad Graduate School of Management, Michigan State University, East Lansing, MI 48824, USA;* [b]*Operations and Decision Technologies Department, Kelley School of Business, Indiana University, Bloomington, IN 47405, USA*

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Purchasing professionals in today's business-to-business (B2B) markets can choose between conducting bid solicitations and negotiations using an online or an offline process. One dominant type of online procurement has been the online reverse auction, which has received both praise and criticism. However, the choice between an online reverse auction and alternate offline procurement methods cannot be taken lightly. It is the objective of this research to distinguish these two environments and investigate their differences along the dimensions of purchase importance, supply market availability, future orientation and item specification difficulty. Examining these issues from the buyer's perspective, we develop our arguments of procurement choice based on literature in industrial buyer behaviour, strategic sourcing, and online reverse auctions; the psychological distance perspective and transaction cost economics serve as theoretical foundations for our hypotheses. Our hypotheses are tested with hierarchical logistic regression analysis using responses from 825 purchasing professionals in the US manufacturing sector. Two of our four main hypotheses are supported, indicating that offline procurement is more likely to be chosen when the purchase is highly important, whereas auctions are the preferred choice as more suppliers become able and willing to participate in the bidding process. No differences were detected between the future orientation of the buyer and the item specification difficulty. Advice is provided to practitioners when reverse auctions are more amenable than offline methods. Contributions to academia include the extension of the literature in industrial buyer behaviour and auctions, as well as the theoretical development based on the psychological distance perspective and transaction cost economics.

Keywords: procurement; online reverse auctions; sourcing decisions; supply management; transaction cost economics; psychological distance perspective; survey research

1. Introduction

The internet and the exponential growth of electronic commerce have been changing the way business is conducted, including procurement in business-to-business (B2B) markets. Purchasers can choose to conduct bid solicitations and negotiations online or offline via traditional methods. The choice between these two models cannot be taken lightly, since

*Corresponding author. Email: Schoenherr@bus.msu.edu

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each method is not appropriate in all instances. The present research brings light into this area and compares online and offline procurement in B2B markets. For the online case we focus on one specific form of online procurement, the online reverse auction. An online reverse auction is a dynamic web-enabled bid solicitation environment in which suppliers bid against each other in real-time, iteratively decreasing the sale price. This competitive environment often leads to significant purchase price reductions. The offline case, or non-use of reverse auctions, represents the status quo, i.e., the use of traditional sourcing approaches, such as face-to-face negotiations. We investigate several characteristics that can impact the choice of environment, and look for explanations why one mode is chosen over the other in certain instances.

Prior studies in this realm covered general rationales for the adoption or non-adoption of reverse auctions (Hartley *et al*. 2004), looked at why firms adopt e-procurement systems (Soares-Aguiar and Palma-dos-Reis 2008), or investigated antecedents and outcomes of e-procurement adoption (Wu *et al*. 2007). However, no research was found that uses results from a large-scale survey to examine the different negotiation environments of online reverse auctions and offline procurement. It is the objective of this research to bring light into this area with a large-scale survey. With that goal in mind, we are also directly fulfilling the call for research issued by Hartley *et al*. (2004, p. 159), who encourage future studies 'to obtain a larger number of e-auction adopters as respondents'. We derive insights based on responses from 825 purchasing professionals in the US manufacturing sector, with about one third of them using online reverse auctions.

A further differentiating aspect of this article is our focus on the request for quotation (RFQ) as the unit of analysis. An RFQ is a detailed description of what an industrial buyer wants to purchase, usually including specifications and requirements related to quality, quantity, delivery, terms and conditions, etc. While RFQs can consist of a single unit, multiple items are usually included (Schoenherr and Mabert 2007a). We investigate this multi-item RFQ scenario, for which the development of an appropriate strategy can be especially challenging (Bakos and Brynjolfsson 1999). This is in contrast to most published studies comparing offline and online procurement, which explored this issue at the enterprise level (e.g., Min and Galle 2003, Hartley *et al*. 2004, Kaufmann and Carter 2004, Mishra *et al*. 2007). Our research, focusing on multi-item RFQs, therefore offers a novel perspective on the use and non-use of online procurement.

Specifically, we compare online reverse auctions and offline procurement along the dimensions of purchase importance, supply market availability, future orientation and item specification difficulty. No research was found that looked at the impact of these four variables on procurement mode choice (offline procurement versus online reverse auctions) within the multi-item RFQ context. We chose the first two variables, purchase importance and supply market availability, due to their criticality in purchase decision making (Kraljic 1983), especially in reverse auctions. The last two variables, future orientation and item specification difficulty, were chosen since they have been cited as the most common inhibitors of reverse auction use (e.g., Mabert and Skeels 2002, Beall *et al*. 2003, Lösch and Lambert 2007). Binary logistic regression is used to develop a framework for facilitating the decision of whether to choose online or offline procurement methods. Our hypothesised predictions are informed by transaction cost economics and the psychological distance perspective.

Overall, this research contributes to the growing literature focused upon B2B markets by using the RFQ as the unit of analysis to compare online and offline procurement across a number of dimensions. We consider the online reverse auction for the 'online' case, while

the 'offline' case constitutes the sourcing of products and/or services via a traditional bidding process not involving online reverse auctions. Results provide insight for academe by grounding the choice between online and offline procurement in theoretical domains, and by testing the hypothesised relationships with a large-scale survey. Further contributions include the extension of the literature in industrial buyer behaviour and auctions, as well as the technology adoption literature (e.g., Craighead and LaForge 2003). As noted by Irani *et al*. (2007), there is a great need to understand the implications of technology adoption. Practising managers benefit from the insights by the provision of a decision support framework, facilitating the selection of the most appropriate procurement approach for their specific operating situation.

2. Literature review and theoretical anchor

Literature in industrial buyer behaviour (IBB) provides a general foundation for the current manuscript. Originating in the late 1960s and early 1970s, this research stream aims to gain a better understanding of industrial buying decisions and processes. Of particular importance were the models by Robinson *et al*. (1967), Webster and Wind (1972), and Sheth (1973), which received much attention. These seminal works can be considered the origin of industrial buyer behaviour research, outlining for the first time in a structured and cohesive way the decision process and behavioural aspects exhibited by the industrial buyer. Johnston and Lewin (1996), who reviewed 165 articles related to IBB that appeared between 1970 and 1995, provide a summary and integrative framework of this research area.

A more specific stream of research used in this article relies on and extends findings related to online reverse auctions. An online reverse auction is a special type of negotiation mechanism that has been gaining popularity since its first use in the late 1990s. Generating a very competitive environment, the tool has received praise for lowering inventory levels, increasing access to new markets, allowing better information transparency, attaining price visibility and increasing competitiveness and efficiency of purchasing (Mabert and Skeels 2002, Beall *et al*. 2003). However, drawbacks include the possibility for unethical behaviour, opportunism (Jap 2007), coercion (Giampetro and Emiliani 2007), and the complexity of the bidding event (Talluri *et al*. 2007). Reverse auctions have therefore been seen in a rather negative light by suppliers, and their long-term sustainability has been questioned. Suppliers may for example engage in retaliation by assigning the buyer a lower priority or by not sharing possible cost-saving developments (Tassabehji *et al*. 2006). The pressure and focus on price alone, the commoditising of products, and the potential damage of the buyer-supplier relationship have been noted as additional disadvantages (Smart and Harrison 2003).

While online reverse auctions may have been rather antagonistic in nature during the early years of their use, further developments and refinements of these tools, as well the development of guidelines and principles, have made them more acceptable to suppliers. As such, Daly and Nath (2005) suggested ways for more relationship-friendly auction designs. Along similar lines, Schoenherr and Mabert (2007b) demystified the notion that reverse auctions damage the buyer-supplier relationship and suggested specific strategies of how a good relationship can be maintained. This was also confirmed most recently in a study by Van Raaij and Caniels (2009), who found that fair procedures can compensate for the suppliers' negative perception and potential dissatisfaction due

to unfavourable auction outcomes. In addition, if approached properly, suppliers can reap significant benefits from reverse auctions. Smart and Harrison (2003) identified a wide range of benefits for suppliers, including potential access to new buyers, a more open tender process, visibility of competitor pricing, knowledge of market activity, increased efficiency compared to a manual bidding process, and a compressed sales order cycle.

This study is anchored in two primary theoretical domains. The first is commonly referred to as the psychological distance perspective. This theory base includes information richness theory, social impact theory, social presence theory, and the concept of psychological distance. *Information richness theory* assesses communication modes according to their information-carrying potential, which can be evaluated based on the immediacy of feedback, the ability to convey multiple social cues, the variety of language it can accommodate, and the ability for personalisation (Daft and Lengel 1984). It is a predictive theory that can suggest what communication mode is chosen (Ngwenyama and Lee 1997). A related theoretical domain is *social impact theory* (Latane 1984), which uses immediacy instead of richness as the differentiating characteristic. Immediacy describes the degree of proximity or barriers present between parties. Another associated theory is *social presence theory* which suggests that the more removed individuals are by communication media, the more parties will treat each other as 'semi-mechanical objects' (Short *et al.* 1976, p. 972). A further related stream of thought is the *concept of psychological distance* (Wellens 1989), with high distance being linked to lower cooperation. All of these theoretical frameworks have been summarised as the *psychological distance perspective*, suggesting virtual communication leading to more depersonalisation and less social impact than face-to-face negotiations (Stuhlmacher and Citera 2005).

The second theoretical anchor is transaction cost economics (TCE). This framework has frequently been employed to explain inter-organisational relationships, and more specifically, whether markets or hierarchies are chosen as the most efficient governance structure (Williamson 1975, cf. McIvor 2009). As bilateral dependence builds up, the most efficient market mechanism moves from transactional market relationships to hybrid contracting and hierarchy (Williamson 2008). This is in accordance to the premise of TCE, which states that transaction-specific investments in the economic exchange and the properties of the transaction should be considered when determining governance structures (McIvor 2009). In our context, transactional market relationships are most closely characterised by online reverse auctions, whereas offline negotiations, an approach that leaves more room for relational aspects to be present, are more equivalent to hierarchies.

Most commonly, the following four factors have been considered as governing TCE (cf. Williamson 1973, 1975, Jones and Hill 1988, Williams 2000, McIvor 2009): (1) bounded rationality, which suggests that perfectly rational decisions by humans are almost impossible, due to the inherent complexities of all possible decisions and alternatives; (2) opportunism, which considers that humans may act out of self-interest to the detriment of the other party; (3) small number bargaining, which relates to the availability of alternate sources of supply; and (4) information asymmetry, which considers the fact that one party (buyer or supplier) may have access to more information or knowledge than the other. Overall, characteristics complicating transactions are usually associated with uncertainty and infrequency, but especially asset specificity, which takes into account the degree of customisation. These aspects of TCE will be used in the following to motivate our hypotheses.

3. Hypothesis development

Hypotheses are developed by integrating the reverse auction and industrial buyer behaviour literature, and anchoring them in the theoretical domains of the psychological distance perspective and transaction cost economics. Additionally, the first two hypotheses are grounded to a large extent in the seminal work of Kraljic (1983), who suggested that a company's sourcing strategy is determined by the importance of the purchased item and the risk inherent in the supply base. The subsequent two hypotheses were derived from existing research for online reverse auctions highlighting two of the most commonly cited inhibitors to reverse auction use: item specification difficulty and future orientation (e.g., Mabert and Skeels 2002, Beall *et al.* 2003, Lösch and Lambert 2007). The complete research model is presented in Figure 1.

3.1 *Purchase importance*

Purchase importance, a central variable in past research explaining industrial buyer behaviour (e.g., Hunter *et al.* 2006), assesses the significance that a particular purchase possesses for the buying organisation (McQuiston 1989). It was central to Kraljic's (1983) stages of purchasing sophistication matrix, and has been used ever since to determine and explain how purchase negotiations should be approached. General research on buyer-supplier relationships found that increased purchase importance leads to a more collaborative relationship (Cannon and Perreault 1999) and tighter integration (Parker *et al.* 2008), and that competitive bidding is most often used for routine and low priority items (Bunn 1993). Applying this reasoning to an online reverse auction would indicate that as purchase importance increases, the likelihood of using online bidding events decreases. While some studies support the claim that non-strategic items are better suited for reverse auctions (e.g., Mabert and Skeels 2002), others find that the degree of an item's strategic importance is only slightly lower in online bidding events (Lösch and Lambert 2007), and that strategic items can also be suitable candidates under certain conditions (Beall *et al.* 2003).

Examining this link from the psychological distance perspective provides further support. Social presence theory suggests that the more removed parties are from each other, the more they will treat each other as abstract entities; the development of personal bonds or relationships can then be much more challenging (cf. Short *et al.* 1976). Due to the rather transactional and often as antagonistic perceived nature of online bidding events

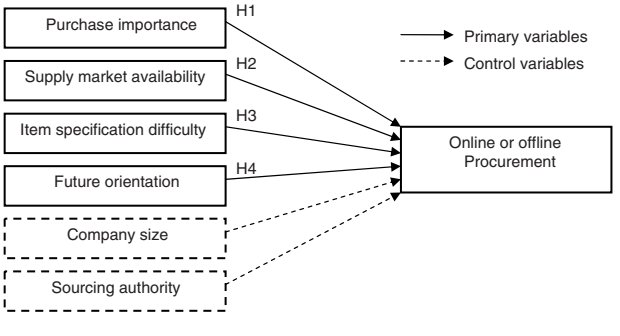

Figure 1. Research model.

(Giampetro and Emiliani 2007), parties are more distant, unless some of the more advanced relationship-building strategies are employed (Daly and Nath 2005). Personal bonds are thus more likely to be generated and fostered via offline procurement. Additionally, increased purchase importance encourages closer ties between the parties (Cannon and Perreault 1999, Parker *et al*. 2008), making offline procurement the preferred approach.

For items with heightened importance purchasers tend to not rely completely on market competition, but engage in more relational and involved approaches, i.e., hierarchies (Williamson 2008). With important items, buyers want to make certain that their supply is secured and to decrease any potential supplier opportunism as much as possible. The likelihood for supplier opportunism can be decreased by the buyer by not acting opportunistically themselves, i.e., by opting out of reverse auctions (Jap 2007). Bounded rationality can also explain the tendency to not use reverse auctions when dealing with important purchases. Since the human mind is limited in understanding all complexities at all times, buyers may want to pursue traditional or face-to-face negotiations when important items are purchased, so as to decrease uncertainties present in the supply market. A more relational approach should therefore be favoured. We therefore formulate our first hypothesis as follows:

H1: As purchase importance increases, the likelihood of using online reverse auctions decreases.

3.2 *Supply market availability*

Supply market availability captures the characteristics of the supply base relative to the extent that alternate suppliers are able and willing to fulfil the buyer's requirements specified in the RFQ. The number of available suppliers can directly influence how industrial buying is pursued: for example, what type of relationship is formed (Cannon and Perreault 1999). The number of available suppliers can also increase the buyer's leverage, which moves the buyer into a better position to require certain types of concessions (Pfeffer and Salancik 1978). This power can influence how supply chain relationships are pursued (Dorling *et al*. 2006), and can enable the more powerful party to drive favoured integration agendas, such as the implementation of inter-organisational systems (Saeed *et al*. 2005). Since reverse auctions are often not favoured by suppliers (Giampetro and Emiliani 2007), increased leverage can enable the buyer to pursue this sourcing approach more easily. It suggests that as supply market availability increases, the likelihood of using online reverse auctions increases as well. This link is supported by the general reverse auction literature, which indicated that appropriate supply market conditions must exist (Kaufmann and Carter 2004), and more specifically, that a larger number of bidding suppliers contributes to a successful and more competitive auction event (Schoenherr and Mabert 2008).

Looking at this argument with the psychological distance perspective provides additional support. Having limited alternatives, buyers should tend to develop stronger bonds with suppliers, using less hostile approaches such as reverse auctions (Giampetro and Emiliani 2007). Therefore, the use of more relational offline methods should foster a closer and more supportive bond between buyer and supplier (Short *et al*. 1976, Wellens 1989).

The number of suppliers that are available can also serve as a proxy for supply base risk or supply uncertainty (Kraljic 1983). Against this background, TCE suggests that

firms tend to favour closer collaboration and vertical integration when uncertainty is high (Williamson 2008). This is especially supported by the TCE component 'small numbers bargaining', which refers to the degree to which alternate sources of supply are available to the buying firm (McIvor 2009). Small numbers bargaining can increase the opportunism of the supplier, which should be avoided in tight supply markets. This leads to our second hypothesis:

H2: As supply market availability increases, the likelihood of using online reverse auctions increases.

3.3 *Item specification difficulty*

Item specification difficulty assesses the complexity, uniqueness or technicality of the individual items included in an RFQ, which can directly impact industrial buying (McQuiston 1989), the purchasing structure (Kotteaku *et al.* 1995), and sourcing decisions (Novak and Eppinger 2001). Specific parallels can be seen in the reverse auction literature (Kaufmann and Carter 2004), where products tend to be of lower complexity (Lösch and Lambert 2007). Product specifications in online bidding events must thus be clear, comprehensive and unambiguous for the auction to be successful (Mabert and Skeels 2002). Such clear specifications are likely to be more easily obtained with standard and established products, in contrast to highly complex, technical or unique items. This argument suggests that as item specification difficulty increases, the likelihood of using reverse auctions decreases.

Theory on psychological distance provides further support (Wellens 1989). With more difficult and challenging items the buyer may want to pursue a closer and more mutually beneficial relationship with suppliers. This can enable collaborative arrangements such as value analysis or new product development. Parties engaged in offline procurement are less likely to be removed from each other (Short *et al.* 1976), share closer proximity (Latane 1984), and are able to share a richer exchange of information (Daft and Lengel 1984).

Additionally, TCE suggests that products with heightened asset specificity are more likely to be obtained via hierarchies rather than markets (Williamson 2008). The exchange should be governed by a more collaborative relationship to avoid opportunism as much as possible, which is likely to occur in situations involving high asset specificity (McIvor 2009). More complex products can also be affected by information asymmetry, which relates to the uneven distribution of information between buyer and supplier. An increase in product complexity usually requires the exchange of additional information which, if not done effectively, can lead to uncertainty and thus information asymmetry (Williamson 1973, Williamson *et al.* 1975). Therefore, high item specification difficulty should lead to a more relational buyer-supplier interaction, rather than an exchange based on market forces. Our third hypothesis reads as follows:

H3: As item specification difficulty increases, the likelihood of using online reverse auctions decreases.

3.4 *Future orientation*

Future orientation is concerned with the long-term direction with which negotiations and the purchase is pursued. Long-term considerations have been said to be mostly absent in online reverse auctions (Giampetro and Emiliani 2007), which therefore entail the risk of

alienating reliable suppliers (Hannon 2003). The psychological distance perspective provides additional support. As such, with heightened psychological distance and depersonalisation in online auctions, social bonds cannot easily develop (Daft and Lengel 1984). This was also suggested by Handfield and Straight (2003) who attest that while good buyer-supplier relationships can develop with online reverse auctions, they are likely not as rich as other forms of negotiation. This lack of information richness, in addition to the depersonalisation promoted by reverse auctions, is likely to be the result of buyers not placing emphasis on future orientation. In contrast, offline negotiations should enable greater immediacy and proximity between the parties (Latane 1984), allowing the parties to be less removed from each other (Short *et al*. 1976). In situations with heightened future orientation the offline negotiation should therefore be the preferred choice.

This position is also supported by TCE. Inherent in the future orientation construct is a desire to avoid opportunism. The characteristics of bounded rationality and information asymmetry can also increase the uncertainty inherent in a relationship, and thus detract from its long-term sustainability and future orientation. Hierarchies can account for these uncertainties and foster a long-term orientation. Therefore, if future orientation is of concern, firms should opt for offline negotiations (hierarchies) rather than online reverse auctions (markets). We therefore hypothesise the following:

H4: As future orientation increases, the likelihood of using online reverse auctions decreases.

3.5 *Control variables*

The study considers two control variables, organisation size and purchasing authority structure. Organisation size has been a central variable explaining the adoption of new technologies (Lai and Guynes 1997). The industrial buying literature has used organisation size as an explanation for larger firms being more proactive and adopting approaches and technologies faster than their smaller counterparts (McDade *et al*. 2002). Recent studies suggested the link between organisation size and the adoption of electronic procurement approaches (Beall *et al*. 2003, Hartley *et al*. 2004, Lösch and Lambert 2007, Soares-Aguiar and Palma-dos-Reis 2008). With an increase in company size, the likelihood of using online reverse auctions should increase as well. As a proxy for organisation size, the total number of employees within the buying company is used (Soares-Aguiar and Palma-dos-Reis 2008).

Since the study and analysis of the buying centre has been central to the industrial buying literature (Johnston and Bonoma 1981), the authority structure present in the sourcing organisation is included as a second control variable. Past research suggested that organisational structure in general, and the organisation of the buying centre in particular, can impact if and when new technologies are adopted. We measure sourcing authority as being centralised, decentralised, or a hybrid structure. Since a central support team can serve as an enabler for reverse auctions adoption, we expect to see higher usage among organisations with a centralised purchasing department.

4. Methodology

4.1 *Measurement items and scales*

Summated rating scales were used to operationalise the four multi-item constructs. The procedure outlined by Churchill (1979) in addition to suggestions provided by

Spector (1992), and Boyer and Pagell (2000) served as guides to deductively and inductively develop the measures. All construct measurement items consisted of a series of statements, to which the respondents were asked to indicate their degree of agreement on a seven-point Likert scale ranging from 'strongly disagree' (value = 1) to 'strongly agree' (value = 7). Higher aggregate values signify stronger agreement with the respective construct being present. The complete set of measurement items for our constructs is provided in the Appendix.

The significance of the items included in the RFQ, as perceived by the company, is measured by *purchase importance*. Our study drew on scales developed by McQuiston (1989), Bunn (1994), and Heide and Weiss (1995), and adapts relevant items to our context. *Supply market availability* captures the characteristics of the supply base; specifically as it relates to the extent to which alternate suppliers are able and willing to fulfil the buyer's requirements. Measurement items for this construct were drawn from extensiveness of choice scales by Bunn (1993), and Cannon and Perreault (1999).

Item specification difficulty assesses the complexity, uniqueness or technicality of the individual items included in an RFQ. We drew on scales by Heide and John (1988), and Cannon and Perrault (1999), with guidance from more recent reports by Mabert and Skeels (2002), and Beall *et al.* (2003). *Future orientation* measures the extent of forward-looking orientation and long-term considerations present during negotiations. Measurement items were adapted mostly from Bunn (1994).

The dependent variable, purchase mode, was operationalised as a binary event. A value of zero was assigned when online auctions were carried out, while a value of one was coded when the negotiations were conducted via traditional offline methods.

4.2 *Data collection and sample*

A large-scale online survey was developed by closely following Dillman's (2000) tailored design method. Respondents of the questionnaire were asked to indicate whether online reverse auctions are used in business negotiations. If used, the respondent was asked to focus on the most recent multi-item RFQ that was put up for bid in an auction. If a respondent did not use reverse auctions, he or she was asked to focus on the most recent multi-item RFQ negotiated offline. Questions that followed then referred to this focal purchase negotiation event. The survey was completed by a random sample of members of the Institute for Supply Management (ISM) employed in manufacturing. We focused on the US manufacturing sector in order to make the study more manageable and to diminish confounding effects.

A total of 825 complete and useable responses were received for this study, representing an effective response rate of 18%. About one third of the respondents (252) were users of reverse auctions and thus answered the questionnaire from the perspective of the most recent multi-item RFQ auctioned online. The remaining two thirds (573 respondents) were asked to focus on the most recent multi-item RFQ negotiated in an offline mode.

The primary types of manufacturers represented in the sample, as indicated by the standard industrial classification (SIC) codes, were miscellaneous manufacturing (24%), electric/electronic equipment (16%), fabricated metal products (9%), and chemicals and kindred products (8%). Respondents were equally distributed across revenue categories, offering a wide range of different-sized companies (Table 1). Almost half of the

Table 1. Organisation size.

Revenue ($)	Frequency	Per cent	Cumulative per cent
$<$50,000,000	114	20.54	20.54
50,000,000–199,999,999	107	19.28	39.82
200,000,000–999,999,999	128	23.06	62.88
1,000,000,000–4,999,999,999	109	19.64	82.52
$\geq$5,000,000,000	97	17.48	100.00

respondents (47%) indicated the purchasing function being assigned to a central organisation (centralised structure), and 14% described purchasing to be decentralised. The remaining respondents (39%) fell in-between these two extremes. Respondents had an average of 16 years experience in purchasing, and the average dollar volume of an RFQ was $6.76 million.

Non-response bias was assessed by comparing early and late respondents to the survey (Armstrong and Overton 1977), with the latter serving as a proxy for non-respondents. The first 200 respondents were compared with the last 200 respondents on a variety of variables (cf. Johnson *et al.* 2007, Flynn *et al.* 2010). No significant differences between the two groups were detected based on spend included in the RFQ ($t(363) = 1.068$, $p = 0.286$), number of employees ($t(389) = 1.122$, $p = 0.263$), number of purchasing employees ($t(392) = 1.275$, $p = 0.203$), company revenue ($t(267) = -0.909$, $p = 0.364$), direct spend ($t(228) = 1.012$, $p = 0.313$), indirect spend ($t(195) = -0.866$, $p = 0.313$), and the percentage of make-to-stock production employed ($t(300) = -0.898$, $p = 0.370$). In addition, a one-sample chi-square test was conducted to assess whether the proportions among categorical variables differed between the early and late respondents. Tests on the response entity indicated (entire enterprise, business unit or division; $\chi^2(2, N = 199) = 2.554$, $p = 0.279$) and purchase authority structure (centralised, decentralised or hybrid; $\chi^2(2, N = 192) = 2.793$, $p = 0.247$) were not significant, further confirming above results.

Another assessment of non-response bias included the investigation of whether the representation of SIC codes among the respondents is significantly different than the representation of SIC codes in the entire address set. This test was possible since ISM provided with their address set the corresponding SIC code of the potential respondent. A chi-square difference test turned out to be not significant, suggesting that the representation of SIC codes among respondents and non-respondents is the same. Non-response bias was thus not regarded as a serious problem.

4.3 *Psychometric analysis*

Confirmatory factor analysis (CFA) was conducted with the four multi-item constructs using LISREL 8.80. A total of nine measurement items were removed, one at a time, based on weak item loadings, cross-loadings, small t-values of the estimates, low multiple squared correlations (R^2), and overall model fit indices. However, items were only deleted if that move could also be substantiated theoretically. The resulting final measurement structure of the four factors exhibited favourable fit statistics (Hair *et al.* 1998, Hu and Bentler 1998): values of 0.99 for CFI, IFI and NNFI, and values of 0.98 for NFI and RFI.

The root mean square error of approximation (RMSEA) of 0.034 ($\chi^2 = 120.38$, $df = 59$) is also well below the threshold value of 0.050 (Byrne 1998). Final measurement items for each construct, including statistical characteristics, are provided in Table 2. Pearson correlation coefficients among our main constructs are presented in Table 3. Multi-collinearity was assessed by examining the variance inflation factors (VIFs); since the VIFs ranged from 1.05 to 1.25 multi-collinerarity was not considered problematic among our data (Neter *et al*. 1996).

Validity and reliability were evaluated following recommendations by Anderson and Gerbing (1988). *Convergent validity* was assessed by examining whether each estimated coefficient loads significantly on its suggested underlying construct (i.e., whether the coefficient is greater than twice its standard error). *Discriminant validity* was tested by examining whether the confidence interval around the correlation estimate includes 1.0. As can be seen from Table 2, these requirements are fulfilled in all instances, establishing convergent and discriminant validity. A more stringent approach to test discriminant validity is to compare the average variance extracted (AVE) to the variances between the constructs (Fornell and Larcker 1981). The AVE measures the amount of variance that is captured by the construct in relation to the amount of variance due to measurement error. To establish discriminant validity, Fornell and Larcker (1981) suggest that the AVE be greater than the corresponding variances. This property was fulfilled in all instances, further confirming discriminant validity. *Unidimensionality* of the constructs was determined via confirmatory factor analysis by assuring that all measurement item loadings

Table 2. Final construct measurement items.

Construct	Variable	Mean	Std dev.	Loading	*t*-value	Std error	R^2
Purchase importance	IMP2	5.44	1.37	0.81	26.80	−0.04	0.65
$\alpha = 0.85$	IMP3	4.86	1.73	0.79	25.62	−0.05	0.62
	IMP4	4.81	1.52	0.87	28.68	−0.05	0.75
Supply market availability	SUPPL1	4.32	1.81	0.87	30.21	−0.05	0.76
$\alpha = 0.89$	SUPPL2	4.51	1.70	0.91	32.02	−0.05	0.83
	SUPPL4	4.73	1.69	0.78	25.91	−0.05	0.61
Item specification difficulty	ITEM1	3.97	1.74	0.90	30.15	−0.05	0.80
$\alpha = 0.84$	ITEM2	4.22	1.74	0.90	30.56	−0.05	0.81
	ITEM3	3.79	1.66	0.61	18.53	−0.05	0.37
Future orientation	FUT1	5.59	1.59	0.70	21.91	−0.05	0.48
$\alpha = 0.85$	FUT2	5.20	1.75	0.80	26.26	−0.05	0.64
	FUT3	5.53	1.60	0.91	31.22	−0.05	0.82
	FUT4	5.30	1.53	0.68	21.41	−0.05	0.46

Table 3. Pearson correlation coefficients.

	IMP	SUPPL	ITEM
SUPPL	−0.115*		
ITEM	0.375*	−0.217*	
FUT	0.290*	−0.048	0.150*

Note: *$p < 0.01$.

were above the suggested threshold value of 0.30 (1989). *Reliability* was determined via Cronbach's alpha, which attained values of 0.84 or higher. *Construct validity* was confirmed by assessing the psychometric properties of content validity, unidimensionality, reliability, convergent and discriminant validity (O'Leary-Kelly and Vokurka 1998). The development and design of our final survey instrument and its measurement items assured *content validity*. Overall, based on these validity and reliability assessments of the constructs, their measurements were judged to be sound.

To test for potential common method bias we utilised confirmatory factor analysis to conduct Harman's single-factor test. If substantial common method bias is present then either a single or a general factor will emerge accounting for most, if not all, of the variables (Podsakoff and Organ 1986). The unidimensional model resulted in a $\chi^2 = 3897.23$ with $df = 65$, which suggests a substantially worse fit compared to the original model described above. Therefore, common method bias is not a serious concern.

5. Statistical analysis

Due to the dichotomous nature of our dependent variable we employed binary logistic regression analysis to test our hypotheses. Using a step-wise approach (cf. Bendoly *et al.* 2007), we commenced with a baseline model containing our controls, company size and sourcing authority structure (Model 0). In a second step we added the two multi-item constructs commonly used to determine sourcing strategy, purchase importance and supply market availability (Model 1). The third step included the incorporation of two additional constructs, future orientation and item specification difficulty (Model 2). Results from this logit model analysis are presented in Table 4.

The baseline model (Model 0) confirmed the predictive strength of firm size, indicated by the significant coefficient as well as the favourable values for the Cox & Snell and the Nagelkerke pseudo R^2 levels. As company size increases, the probability of using online auctions increases as well. Sourcing authority structure, however, had no noteworthy influence in predicting the choice between online and offline procurement. Adding the first group of main effects, purchase importance and supply market availability contributed significantly to the predictive power of the logit model (Model 1) – the -2 log likelihood and pseudo R^2 measures increased significantly. In analysing logistic regression models, predictive ability and statistical significance have commonly been assessed by the change in the -2 log likelihood (-2 LL) value compared to the base model, as well as the Hosmer and Lemeshow measure of overall fit (Hair *et al.* 1998). As can be seen in Table 4, the reduction in the -2 LL value was statistically significant at the 0.01 level when moving from the base model (Model 0) to our first main model (Model 1). In addition, the Hosmer and Lemeshow measure indicates that there was no statistically significant difference between the observed and the predicted classifications. These two measures, in combination, provide support for the acceptance of Model 1 as a significant logistic regression model (Hair *et al.* 1998). Therefore, the data suggests that as purchase importance increases and as supply market availability decreases, firms are less likely to use online procurement auctions, with the control variable for company size remaining significant. This confirms hypotheses H1 and H2.

The addition of two further variables in the next step did not lead to an increase in the strength of the model (Model 2), suggesting that item specification difficulty and future orientation do not influence the choice of online versus offline procurement; therefore,

Table 4. Logit model results.

	Model 0	Model 1	Model 2
Control variables			
Employees (ln)	−0.782***	−0.777***	−0.780***
Sourcing authority[a] = 1	0.135	0.108	0.113
Sourcing authority[a] = 2	0.420	0.378	0.366
Main effects			
Purchase importance		0.187***	0.166**
Supply market availability		−0.135**	−0.129**
Item specification difficulty			0.037
Future orientation			0.021
Constant	6.471***	6.477***	6.489***
−2 log likelihood	674.588	661.946	661.661
Δ−2 log likelihood		12.642***	0.336
Cox & Snell R^2	0.303	0.315	0.315
Nagelkerke R^2	0.425	0.441	0.441
Hosmer and Lemeshow X^2	4.108	5.883	4.516

Note: [a]*Sourcing authority* is a categorical variable with three groups (1 = centralised; 2 = decentralised; 3 = hybrid). The coefficient is relative to be in hybrid sourcing authority;
***$p < 0.01$;
**$p < 0.05$.

hypotheses H3 and H4 are not supported. Nevertheless, the significance of purchase importance and supply market availability is still strong, reinforcing the support for hypotheses H1 and H2.

In a follow-up test we explored the notion that, over time, more important items will be auctioned in online bidding events. This will especially be the case as savings from lower-level items are exhausted and as more sophisticated and detailed auction preparation processes are developed. This speculative prediction is based on our discussions with purchasing managers and our assessment of the field. To explore whether our data already manifests this development we conducted tentative follow-up tests considering the buyer's auction experience. For this investigation we focused on the subsample of 252 auction users and explored the impact of experience on our four main constructs. We were able to do so since our survey instrument included a construct labelled *auction experience*, which consisted of the following items: 'we had limited knowledge about how to conduct an online auction' (reverse coded), 'we had conducted online auctions for a long time', and 'we were very experienced in online auctions'. The reliability of this construct was good, as assessed by Cronbach's alpha (0.993). To assess the relationship between experience and our four main constructs we computed Pearson correlation coefficients. The results indicate that all four comparisons are not statistically significant, and thus do not support our speculative prediction. Future research is encouraged to retest our contention once companies have reached even greater levels of experience, and once the 'easy wins' have been exhausted.

6. Discussion and implications

The argument that as purchase importance increases, the likelihood of using online reverse auctions decreases, was supported. This is in line with literature in industrial buying

behaviour in general (Parker *et al*. 2008), and exploratory findings in reverse auctions in particular (Mabert and Skeels 2002). It is furthermore consistent with our argument based on the psychological distance perspective and transaction cost economics. Nevertheless, it is contrary to the findings in other studies (e.g., Beall *et al*. 2003, Lösch and Lambert 2007) that considered strategic items to be suitable candidates in reverse auctions. This may well be the case, but it requires that a careful and deliberate process be executed preceding the online auction. If such a process cannot be ensured, or for first-time experiences with reverse auctions, then non-strategic items should be selected as auction items. These are safer alternatives with usually lower inherent risk for the organisation; non-strategic items are therefore likely to receive less resistance from within the organisation and are thus also more prone to lead to good results. Non-strategic items are often referred to as the low-hanging fruit (Beall *et al*. 2003), which are easier candidates for reverse auctions. Our finding supports the seminal work of Kraljic (1983) who suggested the use of more relational negotiation approaches for important items. We have confirmed this relationship now in the online versus offline environment, also clarifying the reverse auction debate about the impact of purchase importance. Our arguments based on the psychological distance perspective also suggested the pursuit of closer relationships with increasing purchase importance, making offline procurement the preferred choice. This notion was supported, as were our arguments grounded in TCE. As such, hierarchies are sought for important items to reduce uncertainties and potential opportunism, and to account for bounded rationality; offline negotiations exhibit these traits.

The results confirm our second hypothesis, which associated a greater supply market availability with a higher probability of using online reverse auctions. Based on the literature of industrial buyer behaviour and online reverse auctions we suggested greater supply market availability being associated with increased leverage and bargaining power, making the implementation of reverse auctions a feasible option, even against the reluctance of suppliers. We made similar arguments from the psychological distance perspective in that lower supply market availability should lead to stronger bonds, which in turn can be more easily created via offline negotiations. Also, supply market availability can be seen analogous to small numbers bargaining in TCE and supply base risk in Kraljic's (1983) purchasing portfolio matrix. Our contentions based on these theoretical domains were supported. Therefore, firms contemplating whether to use reverse auctions should assess the number of available suppliers and then determine whether an online bidding event is feasible. If few suppliers are available, the necessary competition may not develop, or incumbents may not feel the need to participate in order to retain the business. In these instances, offline negotiations should be the preferred choice.

The third hypothesis was not supported – item specification difficulty does not impact the likelihood of reverse auction use. This is an intriguing result, especially since literature in industrial buying and reverse auctions suggested item specification difficulty as a determinant of how purchase negotiations are conducted. From a psychological distance perspective the finding suggests that richer information can indeed be exchanged in the online setting. The psychological distance concept, which we argued to be present in reverse auctions, does not impact the complexity of the items that are negotiated. Similarly, from a TCE angle, the higher asset specificity, which would usually be associated with more complex items, did not impact the behaviour of our respondents. Results based on our sample indicate that complex items can indeed be candidates for online reverse auctions. The finding is encouraging for buyers who are contemplating the use of online auctions for more complex items. However, the ability to auction difficult to

specify products does not diminish the importance of having clear, complete and detailed specifications. In fact, having such complete and comprehensive specifications may reduce information asymmetry, as well as some of a product's inherent asset specificity, and thus enable more complex products to be put up for auction in the first place.

The fourth main hypothesis, postulating that future orientation decreases the likelihood of using reverse auctions, was not supported. This is an interesting result since it refutes many past claims that online auctions are short-term oriented (Giampetro and Emiliani 2007). Although reverse auctions may be perceived as such, it is not always the buyer's intent. There are certain measures the buyer can take, such as educating and training the supplier, and using an objective and unambiguous process, to demonstrate to the supplier that they are in for the long-haul and a good relationship as well. While these approaches may not have been used in the early years of reverse auctions, they are becoming more popular nowadays; this provides a possible explanation for our unsupported hypothesis. The result illustrates the importance of how each negotiation mode is handled, rather than which one is chosen. Approached appropriately, reverse auctions do not have to lead to greater psychological distance between the parties. In addition, opportunism, information asymmetry and uncertainty do not have to govern the relationship, as postulated by TCE. In fact, a more relational approach to reverse auctions, as described in Daly and Nath (2005), and Schoenherr and Mabert (2007b), may make this tool a feasible option in many more instances than originally anticipated.

7. Conclusion

Our research makes several contributions. Four dimensions were developed and hypothesised to be differentiators between online auctions and offline procurement based on the literature of industrial buyer behaviour and online reverse auctions. Two dimensions were derived from Kraljic's (1983) portfolio matrix and two dimensions were based on the most often cited factors influencing the adoption of online auctions. The psychological distance perspective and transaction cost economics served as theoretical anchors. We were able to collect a very large set of respondents (over 800), which is significantly more than prior related studies, and derive insights for academics and practising managers. The present research provides a response to the call for obtaining 'a larger number of e-auction adopters as respondents' to test such relationships (Hartley *et al.* 2004, p. 159). We also follow the agenda for future research outlined by Kaufmann and Carter (2004), who encourage supply chain management researchers to use their qualitative research and review as input for a more quantitative analysis. We operationalised and investigated item specification difficulty (what Kaufmann and Carter call 'specifiability') and supply market availability (what Kaufmann and Carter call 'rivalry among the participating suppliers'), grounding these issues in conceptual perspectives, confirming them and extending theory.

Future research in this area is multifarious. One topic worthy of further exploration is the expansion of potential influencing determinants for the choice of procurement mode. As such, different goals may be pursued based upon the choice of a certain environment; for example, a focus on cost reduction versus supply base consolidation versus partnership development will likely influence the online or offline preference. While each of these goals may be present in a particular purchase situation, their differing intensity levels should be explored and their subsequent influence on procurement mode investigated. A second

avenue for future research should be the incorporation of some type of performance metric assessing the success of the procurement approach. While percentage savings compared to a prior purchase of the items has been a popular approach, other quantitative and qualitative measures should not be neglected. A more complete metric incorporating cost, quality, service, reliability, delivery, and other less tangible measures, in a weighted fashion would be more representative. A third area of investigation is the possible impact of using online procurement approaches on quality and/or service. It has been said that reverse auctions are perceived as an antagonistic way of doing business by many suppliers, and that there could be a pushback. Finally, an interesting issue to examine includes then whether suppliers retaliate later, with poorer quality or a lower service priority assigned to the buyer. Whatever the results may be, online reverse auctions remain a fascinating area for study.

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Appendix. Construct measurement items

Respondents were asked to indicate their degree of agreement with various statements related to the focal purchase on a seven-point Likert scale ranging from 'strongly disagree' (value = 1) to 'strongly agree' (value = 7). Reverse coded items are denoted by (R).

Purchase Importance

The following statements assess the importance that the items in the bundle have for your company. Please indicate the extent to which you disagree or agree.

IMP1	As a portion of our total spend, this bundle's dollar volume was high
IMP2	The items in this bundle were important for the good operation of our company
IMP3	The items supported a core competency of our company
IMP4	Compared to other purchases, the bundled items were important
IMP5	An unsuccessful outcome of the RFQ would have had only minor consequences (R)

Supply Market Availability

The next statements are concerned with the number of suppliers that could have bid on the entire bundle. Please respond by indicating the extent to which you disagree or agree.

SUPPL1	Many companies could have supplied us with all the items in the bundle
SUPPL2	There were a lot of qualified and capable suppliers
SUPPL3	Bidding was competitive
SUPPL4	Many suppliers had the necessary capabilities to produce all items in the bundle
SUPPL5	Many suppliers possessed the required capacities

Item Specification Difficulty

Please indicate your disagreement or agreement with the following characteristics describing the majority of individual items in the bundle, compared to other items your firm purchases.

ITEM1	Complex
ITEM2	Technical
ITEM3	Easy specifications (R)
ITEM4	Low engineering content (R)
ITEM5	Unique
ITEM6	Custom-designed

Future Orientation

The next statements deal with whether future-looking / long-term considerations played a role when constructing the bundle. Please indicate the extent to which you disagree or agree.

FUT1	We did not give any thought to the long-term supply (R)
FUT2	We primarily focused on short-term goals (R)
FUT3	Long-term considerations did not play a role (R)
FUT4	Future plans were an important issue
FUT5	We considered long-term purchasing objectives