

Examining the effects of source selection method on procurement outcomes

Effects of
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Abstract

Purpose – The purpose of this research is to explore the effects of supplier selection method on key procurement outcomes such as procurement lead time (PLT), supplier performance and buyer team size.

Design/methodology/approach – Data were collected from a sample of 124 archival contract records from the US Department of Defense. A multiple regression model and multivariate analysis of covariance/analysis of covariance models were used to test the effects of source selection method on pertinent procurement outcomes.

Findings – The trade-off (TO) source selection method increases PLT, as does the number of evaluation factors and the number of proposals received. Substantially larger sourcing teams are also associated with the TO source selection method. Nonetheless, the TO method results in better supplier performance.

Practical implications – TO source selections yield superior supplier performance than low-bidder methods. However, they are costly in terms of time and personnel. Any assessment of supplier value should consider not only the price premium for higher performance but also the transaction costs associated with the TO method.

Originality/value – Very little research addresses a buying team's evaluation of supplier-offered value *ex ante* and whether that value assessment materializes into actual value-added supplier performance. Low bidder tactics are pervasive, but price (i.e. sacrifice) is only one component of value. Benefits from superior supplier performance may yield greater overall value. If value is critical to the buyer, a TO source selection method – versus a low-bidder approach – is the appropriate tool because of higher supplier performance *ex post*.

Keywords Procurement, Supplier performance, Source selection, Supplier evaluation

Paper type Research paper

Introduction

One of the most hotly contested debates in defense procurement has been the choice of contractor selection method and the procurement outcomes resulting from that choice (Kashiwagi and Byfield, 2002; Lohfeld, 2015). The low-price, technically acceptable (LPTA)



method has been pitted against the full trade-off (TO) method, with the LPTA method taking the brunt of the criticism. While Department of Defense (DoD) policies encourage contracting officers to:

[...] select the appropriate source selection process [...] to match the specific requirement, meet Warfighter needs, and deliver a contracted solution that will provide the required performance levels at the lowest cost (Kendall, 2015, p. 3).

Stakeholders have differing views about how the choice of contractor selection method affects procurement outcomes.

Different buying situations call for different source selection methods (De Boer *et al.*, 2001). Whether to use an LPTA or a TO source selection method is not always clear; it is often a judgment call (Nichols and Totman, 2013). One source selection method is to specify minimum levels of performance and minimum qualifications, then to select the lowest-priced offer (Ellram, 1995). The LPTA approach resembles a competitive bid (i.e. “low-bidder”) method and assumes well-defined requirements that fully meet the internal customer’s needs (Gransberg and Ellicott, 1997). The LPTA approach, therefore, is suited to more definable and stable requirements of moderate or low risk. The LPTA method is quite useful for the purchase of non-critical goods and services, for which the goal is to satisfy the need while transacting in the most efficient manner (Kraljic, 1983).

Government acquisition officials attest that the LPTA selection method offers a faster time-to-contract, as the technical acceptability criteria is binary and the evaluation of price – the most important factor in LPTA contractor selections – is objective (GAO, 2014). As it is more objective, the LPTA method is also less likely to be protested – a weighty consideration of government acquisition teams (Hawkins *et al.*, 2016). The sellers’ perspective, however, is that the LPTA method stifles innovation, because price is more important than, say, an innovative approach that may ultimately better serve the government (Calisti, 2015). Critics argue that the LPTA method often results in the selection of a contractor that has undercut the cost of the procurement (Walenta, 2015). They argue that the contractor has essentially achieved “buy-in” by proposing an unreasonably low price that will later have to be adjusted (i.e. increased) via contract modification to fulfill the terms and conditions of the contract. In an LPTA source selection method, suppliers are motivated to minimize price and to meet – but not exceed – minimum qualifications and performance levels. As buyers often fail to adequately define requirements (Hawkins *et al.*, 2015), the method, then, can result in receiving less performance than truly needed. Opponents also feel that LPTA contractor selections yield inferior products and services (Weckstein and Delgado, 2012). Proponents, however, suggest this is not the case, and that by providing clear technical acceptability criteria, the government can avoid receiving inferior products and services (Nichols and Totman, 2013).

A separate source selection method is to specify minimum qualification and performance thresholds, and then to permit a TO analysis, thus enabling the buyer to pay a higher price for qualifications or performance levels that are higher than the minimum requirements (Carter and Choi, 2008). The TO method fits situations that are rich in uncertainty, risk and high stakes (Rendon and Snider, 2008). The TO contractor selection method is perceived to take more time because of the subjective nature of the proposal evaluation process and the increased likelihood of receiving a bid protest (Hawkins *et al.*, 2016). Internal customers and contractors seem to prefer this approach, as it allows customers to retain control over selecting the contractor that represents the best value – that by ranking the evaluation factors in terms of importance, they have the option of tailoring the evaluation to fully meet their needs. Contractors also seem to prefer this method, as it allows them to provide

innovative solutions without the burden of competing mainly on price. By the scaled rating of past performance (i.e. not just pass/fail), the TO method also allows contractors to compete on their record of past success, on their reputations, and, consequently, on risk to the buyer. Proponents of the TO method argue that it results in higher-quality products and services because contractors are not “squeezed” on price (Gransberg and Ellicott, 1997). Opponents argue that the TO method does not necessarily produce better contractual outcomes, particularly given the anecdotal belief that TO procurements takes longer to award (Bunting, 2014).

The DoD’s use of the LPTA method rose 10 per cent (from 26 to 36 per cent of competitive source selections over \$25m) from fiscal years 2009-2013, whereas simultaneously the use of the TO method decreased 11 per cent (from 69 to 58 per cent) (GAO, 2014). The Government Accountability Office attributed the increase in LPTA usage to the DoD’s Better Buying Power initiative that emphasized affordability and efficiency in defense spending (GAO, 2014). Government contractors’ opposition to the growth in LPTA usage grew, and Congress mandated the GAO review the DoD’s use of best value source selection processes (GAO, 2014). That review found no inconsistencies with policies, but ignored the larger issue of whether an LPTA selection method deserves its criticism.

Surprisingly, a dearth of research examines the links between source selection methods and procurement results (Bajari *et al.*, 2009). The purpose of this research, therefore, is to explore the effects of supplier selection method on key procurement outcomes – procurement lead time (PLT), supplier performance and transaction costs. Exploring the differences is important because buyers may not enable the co-creation of the most value if an inappropriate source selection method is used. While total cost of ownership is commonly evaluated, it is not the same as value, as it can ignore many of the supplier-bearing benefits. Further, as offerings become commoditized, buyers might over-rely on price as incorporating all of the information the buyer needs to make an effective purchase decision. But, price alone may not fully indicate value. This research extends prior research on supplier selection methods by linking the buyer’s underlying true need – value – to the effects of a price versus non-price TO decision.

The remainder of this paper proceeds as follows. First, the relevant literature is reviewed starting with a discussion of information-processing theory. The section concludes with a set of hypotheses positing relationships between source selection method and key sourcing outcomes. Next, the data collection and analysis methodologies are discussed. Results are reported, and corresponding practical and managerial implications are offered. The study concludes with a discussion of limitations and areas for further research.

Theory and hypotheses

In essence, the principal issue at hand is the value acquired by both sides of the buyer–supplier dyad. Value is the undercurrent of sourcing decisions as buyers lean on suppliers for cost savings and competitive advantage (Chin-Chun *et al.*, 2006). Value is the net difference between benefits gained (e.g. lower-cost inputs from suppliers, superior quality goods and services purchased from suppliers) and sacrifices made (e.g. price paid) (Lam *et al.*, 2004; Yazdanparast *et al.*, 2010). During source selection, the value determination manifests in the evaluation of price versus non-price evaluation criteria. Surprisingly, very little research addresses how buying teams evaluate value *ex ante* (Koufteros *et al.*, 2012).

In assessing value using the LPTA source selection method, essentially, the buyer determines the desired benefits *ex ante* then the supplier determines the associated required sacrifice (i.e. the price). This method consumes less time because the benefits are pre-determined; they need not be evaluated in each supplier’s proposal. But under the TO source

selection method, the buyer is able to consider purchasing more value by allowing the supplier to offer greater than the minimum performance levels and qualifications (i.e. greater benefits). A TO method consumes more time, as buyers must evaluate the unique benefits offered by each supplier, and then must meticulously document how the added benefits are worth the added costs to such an extent to withstand public scrutiny. A TO method also introduces the risk of biases (Kaufmann *et al.*, 2010) and mistakes in evaluations, as assessing value is not easily accomplished and is often subjective.

It follows, then, that if the buyer opts to purchase greater anticipated value that decision would manifest in greater benefits such as superior supplier performance. Two key procurement outcomes are lead time (Cavinato, 1987) and supplier performance (Sánchez-Rodríguez *et al.*, 2005). PLT is crucial because it determines when an internal customer's needs will be met. PLT can also affect inventory levels and, thus, carrying costs. Less time between planning and delivery also increases forecast accuracy, which, in turn, decreases safety stock inventory. Supplier performance is also critical, as suppliers are increasingly relied upon and their performance can affect a buyer's competitive advantage (McCue and Johnson, 2010), financial performance, lead times, innovation and quality (Kannan and Tan, 2006).

Supplier selection, in general, has been researched extensively. However, very little research links supplier selection to either buyer or supplier performance. Table I summarizes these few studies. As can be seen in Table I, some of these studies frame the buyer's desired outcome as value, whereas many do not. From this literature, it is clear that supplier selection criteria affect supplier and buyer performance. However, it is not so clear how this effect transpires. None of the studies explore the effect of source selection method (i.e. competitive bidding/LPTA versus TO) on added value.

Information processing theory

Cross-functional sourcing teams add value not by producing a tangible outcome but by using information to consummate an agreement with suppliers and by managing relationships with internal and external stakeholders. Competitive bidding and negotiations are contract award mechanisms for transmitting information between organizations (Goldberg, 1977).

Information processing theory offers valuable insights in this regard. It has served as a foundation in a variety of supply chain contexts to:

- develop organizational response strategies to supply disruptions (Bode *et al.*, 2011);
- explain the adoption of cloud computing technologies (Cegielski *et al.*, 2012); and
- explain procurement performance (Premkumar *et al.*, 2005).

The premise of information processing theory is that greater uncertainty of a task drives a need for greater information processing to execute the task and achieve a certain level of performance (Galbraith, 1974). "Uncertainty is defined as the difference between information possessed and information required to complete a task" (Tushman and Nadler, 1978, p. 615). Uncertainty prevents organizations from planning task execution *ex ante*, and often requires organizations to react to changed circumstances *ex post*. Uncertainty is affected by task complexity, intra-unit task interdependence, inter-unit task interdependence and dynamism of the task environment (Tushman and Nadler, 1978). Organizations may use two basic strategies to accommodate increased uncertainty – decrease the amount of information required to be processed to complete a task or increase capacity to process information (Galbraith, 1974). The fit between information processing needs and information processing

Reference	Method	Theory	Source selection method effects on buyer or supplier performance	Value as the selection outcome	TO of price and non-price criteria for added value	Key findings
Bajari et al. (2009)	Logistic regression <i>n</i> = 4,087 construction projects	N/A	No	No	No	More complex projects are more likely to be awarded by negotiation than by auction. An increase in work volume is related to negotiations (vs competitive bidding). Negotiated projects tend to be awarded to larger, more experienced suppliers
Goldberg (1977)	Conceptual	N/A	No	Yes	No	N/A
Ittner et al. (1999)	Regression and recursive partitioning, survey, <i>n</i> = 249	N/A	Yes	No	No	Use of supplier partnership practices without the appropriate supplier selection and monitoring practices results in lower buyer profit and quality, examines only non-price selection criteria, treats selection and monitoring as one variable
Kannan and Tan (2006)	SEM, <i>n</i> = 527	Relational exchange	Yes	No	No	The greater the importance of select non-price evaluation criteria, the greater the success of the buyer-supplier relationship (comprising higher product quality, lower cost, less product development time and more cooperation)

(continued)

Table I.
Relevant literature

Table I.

Reference	Method	Theory	Source selection method effects on buyer or supplier performance	Value as the selection outcome	TO of price and non-price criteria for added value	Key findings
Kaufmann <i>et al.</i> (2014)	Regression, $n = 54$ sourcing teams	Dual process theory	Yes	No	No	Distinguished financial from non-financial supplier performance The use of rational supplier selection procedures increases cost performance but not quality delivery or innovativeness. When sourcing team members use their experience-based intuition, the decision results in satisfactory supplier performance in terms of quality, delivery and innovativeness
Koufteros <i>et al.</i> (2012)	SEM survey, $n = 157$	Resource-based view	Yes	Yes	No	Supplier selection using criteria of new product development, quality and cost directly affect the buyer's performance in those respective domains
Mesching and Kaufmann (2015)	Regression, survey, $n = 88$	Group decision-making theory	Yes	No	No	Consensus on objectives for supplier selection among sourcing team members is positively related to the selection of higher performing suppliers
Nair <i>et al.</i> (2015)	SEM survey, $n = 244$	Organization theory	Yes	No	No	The importance of supplier selection criteria (strategic and operational measures) are positively related to supplier performance (strategic and operational measures). Supplier performance, in turn, affects buyer performance

(continued)

Reference	Method	Theory	Source selection method effects on buyer or supplier performance	Value as the selection outcome	TO of price and non-price criteria for added value	Key findings
Skoumpopoulou <i>et al.</i> (2014)	Single case study	N/A	No	Yes	No	Price is the main deciding factor in selecting a supplier Reviews three supplier selection methods: the categorical method (de Boer, Labro and Morlacchi, 2001), the cost-ratio method (Thompson, 1990) and the weight-point methods (Arsan and Shank, 2011)
van der Rhee <i>et al.</i> (2009)	Discrete choice analysis, survey, $n = 200$	N/A	No	No	No	Explores TOs of cost, delivery, flexibility and service given a minimum level of quality (resembling LPTA). Flexibility is the most important selection criterion for commodities and cost is second
Vonderembse and Tracey (1999)	Correlations, t -tests survey, $n = 268$	N/A	Yes	No	No	The product quality and product performance dimensions of supplier selection criteria are positively correlated with manufacturing performance

Table I.

capability affects firm performance (Premkumar *et al.*, 2005). To decrease the amount of information processing required, organizations can create buffers or create self-contained tasks. To increase information processing capacity, organizations can implement information systems that improve and speed information flow (i.e. decrease uncertainty) or create lateral relations (Galbraith, 1974). The ensuing discussion will elaborate the particular information processing requirements of the procurement process.

Procurement process

The industrial purchasing process can be complex and lengthy spanning many internal organizations, multiple tiers of external suppliers and numerous approval authorities. The process includes several steps: identifying needs, defining user requirements, deciding to make or buy, identifying the type of purchase, conducting market research, determining terms and conditions, allocating risk, identifying prospective suppliers, prequalifying sources (Sarkar and Ghosh, 1997), evaluating suppliers, analyzing price and cost, negotiating, selecting suppliers, receiving product and/or service delivery, conducting post-purchase monitoring and evaluation (Novack and Simco, 1991), negotiating changes, resolving disputes and executing payment.

With the advent of strategic sourcing, these fundamental steps have been enhanced with additional processes such as spend analysis, supply segmentation (Kraljic, 1983), reverse auctions (Hawkins *et al.*, 2009), strategic cost management (Elram, 2002), supplier development (Krause, 1997; Krause *et al.*, 2000), supplier relationship management and early supplier involvement (Monczka *et al.*, 2015). Because of the substantial portion of a buying firm's revenue that is supported by purchased goods and services, the efficacy of the procurement process can determine whether an organization reaps a competitive advantage or disadvantage (González-Benito, 2007). It is through each step that information is processed and a supplier's performance is realized by the buying organization.

Buffering via procurement lead time

Information processing theory posits that buffering via slack resources can decrease the amount of information processing required (Galbraith, 1974). A common physical application is the increase in safety stock to accommodate variability in demand. However, an intangible resource – time – may also serve as a buffer (Galbraith, 1974). If the time allowed to award a contract is extended, the buying organization can prolong the processing of information throughout the sourcing process, thereby alleviating the need to expand information processing capacity.

Properly executing the procurement process can consume significant time (van der Valk *et al.*, 2009). Government procurement in particular is lengthy because of the extensive, peculiar regulatory and statutory requirements such as ensuring transparency and fairness, meticulous documentation, bid protests, the Small Business Act, the Truth in Negotiations Act and the Competition in Contracting Act. The effective selection of procurement methods demands quality and timely information and a careful consideration of alternatives (Naoum and Egbu, 2015). LPTA supplier selections typically occur with requirements that are well-defined. As the minimum performance levels and qualifications are pre-specified, the LPTA supplier selection method generally lends itself to greater objectivity than does the TO selection method. TO source selections permit suppliers to offer levels of performance and qualifications greater than the minimums, and evaluating each supplier's unique offer takes time to assess the unique value. Time is also required to deliberate internally on just how much value the buyer is willing to purchase. Therefore, it is posited that:

H1. A TO source selection method will have longer PLT than will an LPTA source selection method.

Supplier performance

Low-bidder methods assume that the buyer has fully and accurately defined its requirements such that the suppliers share with the buyer common understandings of the required effort and outcomes, in their entirety. Often, technical ignorance, errors of omission and mistakes in defining requirements preclude this assumption from becoming reality (Hawkins *et al.*, 2015; Goldberg, 1977). While the supplier might satisfy the contractual requirements as written, it may not meet the true needs. Additionally, in an environment in which a supplier is incentivized to minimize price, the lowest-cost inputs will be pursued. This could manifest in lower-qualified personnel, older or less capable equipment, cheaper quality materials or a lower profit margin (and, hence, less room for error). And, during performance, the supplier is incentivized to find ways to further cut costs (e.g. shirking quality). Thus, actual performance may be lower than expected.

Conversely, using the TO selection method, the buyer assesses sources of value such as fewer quality defects, a stronger reputation of superior past performance, faster delivery and better delivery reliability. The buyer then consciously determines whether higher levels of these performance elements yield superior value – even in the face of a higher price. Thus, it should be expected that:

- the buyer has conducted its due diligence in validating the supplier's promises of performance in its proposal;
- the buyer has verified the supplier's record of strong performance satisfying its other customers; and
- the buyer has consciously and accurately determined that the supplier's offer will yield the best value – perhaps for a greater price – then the supplier should deliver greater value than if minimum performance levels set by the buyer were pursued by the supplier.

Indeed, Goldberg (1977), in his discussion of pre-contractual complexities, suggested that the bidding process has a significant impact on the nature of the supplier's output. As such, it is posited that:

H2. Supplier performance will be better when the supplier was selected via a TO, rather than an LPTA, source selection method.

Transaction costs

Source selection in a business-to-business context is often a labor-intensive process. While e-commerce platforms can facilitate the documentation and transmission of requests for proposals, specifications, drawings and line-item pricing, proposal evaluation is largely performed by procurement personnel and varying numbers of subject matter experts. Generally, the greater the amount of information that must be evaluated, the larger the scope of the contract, and the greater the risk of unsuccessful supplier performance, the more people will be needed to adequately assess the suppliers' proposals against the evaluation criteria. Further, in TO source selections, additional man-hours will be required to quantify the benefits of each supplier's proposal, then to consider whether to pay the increased price (i.e. sacrifice) for the added benefits (i.e. value). In other words, more people can evaluate

more information; thus, information processing capacity is increased. However, capacity is not free, with more people, transaction costs are also increased. Some buying organizations may choose an ill-suited source selection method (e.g. LPTA for a high-risk, less-defined requirement) for this reason. Thus, it is posited that:

H3. The size of the buying team will be greater for source selections using the TO method versus the LPTA method.

Methodology

Data collection

For this research, the appropriate unit of analysis was the transaction. To collect the data, five teams of graduate students accessed procurement data from a convenience sample of seven different U.S Air Force and U.S Navy procurement offices. The students extracted the data via a manual search of contract files from these offices. High-value contracts (over \$750,000) were requested from the procurement offices to ensure sufficient complexity in the source selection process. While we requested high-value contracts, not all were above \$750,000. In total, 24 contracts fell below our requested threshold, but only seven contracts (5.6 per cent) were below the simplified acquisition threshold of \$150,000. Based on these numbers, we determined the sample to be sufficiently complex. Contracts were randomly chosen by personnel from the seven different offices. The resultant sample size was 124 contracts, 80 per cent of which were purchases greater than \$1m. The average purchase price among all contracts was \$26.4m. Of these contracts, 69 recorded supplier performance ratings and 116 recorded buying team sizes, resulting in smaller sample sizes for *H2* and *H3*.

Measures

The key consequences of source selection method (i.e. the dependent variables) are meant to provide answers about how long the sourcing process took, how well the supplier performed and the cost of the transaction. Accordingly, the dependent variables include

- PLT;
- contractor performance assessment reporting system (CPARS) ratings as a measure of contractor performance; and
- buyer team size as a measure of transaction cost.

PLT was measured by the number of days from the issuance of the request for proposal to the contract award. CPARS data were collected and used for the following performance categories:

- cost control;
- quality;
- schedule; and
- business relationship.

CPARS measures each category using the following Likert-style scale: 1 = unsatisfactory, 2 = marginal, 3 = satisfactory, 4 = very good and 5 = exceptional. Buyer team size was measured by the number of people who participated on the source selection team.

Independent variables included source selection method, number of offers, a number of evaluation criteria and value of the contract. Consistent with prior research (Bajari *et al.*, 2009),

the contract value was included as a proxy for complexity. As complexity is expected to affect the key procurement outcomes investigated in this research (lead time, buying team size and supplier performance), it is modeled as a control variable. Source selection method was a binary variable with LPTA coded as zero and TO as one. The number of offers represented a count of the number of proposals received. The number of evaluation criteria was measured as counts of criteria used to discriminate between proposals. Contract value was measured in US dollars.

Assumption testing

Several assumptions were tested before proceeding. The assumptions for each analysis are described below.

Multiple regression. We test the relationship between source selection method and PLT (*H1*) using multiple regression. Prior to analysis, we searched for outliers and influential observations and found none. PLT, number of offers and value received a logarithmic transformation to achieve normality of the residuals. There were no issues with linearity, multicollinearity [all variance inflation factors (VIF) < 2] or autocorrelation. The Breusch–Pagan test showed heteroscedastic errors, but Cameron and Trivedi’s test did not. Heteroscedastic errors can result in biased *t*-statistics. To be safe, we confirmed our results using a robust estimation technique that estimates standard errors using Huber–White sandwich estimators. With this technique, the coefficient estimates remain exactly the same as in ordinary least squares (OLS) regression; however, the standard errors produced by this method are robust to heteroscedasticity because they are derived from the empirical data rather than the model, thus correcting the bias in the *t*-statistics. Despite using robust standard errors, results were not changed.

Multivariate analysis of covariance/analysis of covariance We look for source selection method induced differences in supplier performance (*H2*) and transaction cost (*H3*) using multivariate analysis of covariance (MANCOVA) and analysis of covariance (ANCOVA). Prior to the MANCOVA and ANCOVAs, we searched for multivariate outliers and influential observations and found none. The CPARS and buying team size data achieved multivariate normality for each source selection method. We also considered the normality of the covariates, as covariates are useful in reducing error, but not if they are non-normal and thus reduce power (Tabachnick and Fidell, 2007). As before, number of offers and value received a logarithmic transformation to achieve normality. There were no issues with linearity, multicollinearity (VIFs < 2.01), homogeneity of regression or homogeneity of variance/covariance matrices (Box’s $M \chi^2(3) = 1.63, p = 0.6517$). All observations were independent, and because we used an average the four CPARS ratings, the dependent variables are both continuous in nature.

All further analyses and statistical output use the transformed variables; however, the written results back-transform the variables into their original form for a better understanding of the effects. We use the untransformed variable nomenclature in the text for ease of reading.

Results

Descriptive statistics

The contracts ranged widely in terms of PLT, dollar value and number of offers received. Most source selections involved a small number of non-price evaluation criteria. A wide variety of types of goods and services were included (Appendix). Basic descriptive statistics for variables and demographics are shown in Table II.

Variable	Observation	Mean	SD	Minimum	Maximum	Grouping variable
PLT	<i>124</i>	<i>290.13</i>	<i>251.97</i>	<i>8</i>	<i>1019</i>	–
(days)	55	147.16	112.76	8	482	LPTA SS
	69	404.09	273.92	21	1019	TO SS
CPARS	69	4.00	0.78	2.5	5	–
(average rating)	20	3.64	0.67	3	5	LPTA SS
	49	4.15	0.79	2.5	5	TO SS
Buying team size	116	8.03	8.22	1	54	–
	49	3.69	2.27	1	11	LPTA SS
	67	11.22	9.45	2	54	TO SS
Contract dollar value	124	<i>\$26,400,000</i>	<i>\$58,500,000</i>	<i>\$27,819</i>	<i>\$410,000,000</i>	–
	55	\$2,419,850	\$3,346,636	\$27,819	\$20,000,000	LPTA SS
	69	\$45,600,000	\$73,100,000	\$36,000	\$410,000,000	TO SS
Number of evaluation factors	124	2.62	0.81	1	5	–
	55	2.13	0.55	1	3	LPTA SS
	69	3.01	0.78	2	5	TO SS
Number of offers	124	4.45	4.52	1	23	–
	55	4.00	4.57	1	23	LPTA SS
	69	4.81	4.47	1	22	TO SS

Table II.

Descriptive statistics

Notes: The italicised rows denote overall mean values – including LPTA SS and Tradeoff SS sub-groups; whereas, non-italicised rows denote only means of the sub-groups (i.e., LPTA SS or Tradeoff SS)

Multiple regression

H1 was tested using multiple linear regression. Table III displays parameter estimates, significance levels and the explanatory power of the model. The model is given as:

$$\ln(Y) = b_0 + b_1 \times \ln(X_1) + b_2X_2 + b_3X_3 + b_4 \times \ln(X_4) + \varepsilon$$

DV: PLT	Unstandardized coefficient	Standardized coefficient [^]	t	P > t	Significance
Intercept	1.714	–	2.87	0.005	
<i>Explanatory Variables:</i>					
Number of offers	0.197	0.110	2.10	0.038	**
Number of evaluation criteria	0.243	0.223	2.08	0.040	**
Source selection method	0.310	0.281	1.67	0.098	*
<i>Control:</i>					
Lnvalue	0.163	0.263	3.47	0.001	***
Adjusted R ²	0.38				
Prob > F	20.22			0.000	***

Table III.

Regression results

Notes: Significance level *** < 0.01; ** < 0.05; * < 0.10; ^Results based on untransformed variables

where:

- Y = PLT
- X1 = number of offers
- X2 = number of evaluation criteria
- X3 = source selection method
- X4 = value

As seen in Table III, all four predictors show significant path estimates, with source selection method showing the strongest effect on PLT, but only achieving marginal significance. Additionally, a respectable amount of variance in PLT (38 per cent) was explained by the four independent variables. Given these results, *H1* was supported.

Multivariate analysis of covariance and analysis of covariance

Because our intent was to analyze differences in contract outcomes (CPARS ratings and buying team size) based on contractor selection methodology (LPTA or TO), a group comparison statistical methodology was necessary. We seek to find whether there are differences in contract outcomes (CPARS ratings and buying team size) by group while controlling for the effect (s) of influential covariates (i.e. the number of offers, number of evaluation criteria and contract dollar value). To do this, we performed a MANCOVA with CPARS ratings and buying team size as the DVs. Source selection method and dollar value significantly affect the DVs [Wilks' $\Lambda = 0.453$, $F(8, 106) = 6.44$, $p < 0.001$]. Wilks' Λ shows that over 50 per cent of the variance in the outcome variables is explained by source selection method and the covariates. We performed individual ANCOVAs on each of the DVs to better understand these results.

Table IV provides the results of the ANCOVA with CPARS ratings as the DV. Clearly, TO source selections result in more favorable supplier performance (mean CPARS rating for LPTA = 3.64, mean CPARS rating for TO = 4.15), supporting *H2*. Sample-based means are provided for each of the covariates. The amount of variance in CPARS ratings explained by source selection method was a modest 7 per cent (Adjusted $R^2 = 0.070$, $n = 69$), suggesting other variables might help explain CPARS ratings.

Table V provides the results of the ANCOVA with buying team size as the DV. TO source selections significantly increase the size of the team needed to properly manage the source selection process (mean buying team size for LPTA = 3.69, mean buying team size for TO = 11.22), supporting *H3*. Again, sample-based means are provided for the covariates. Taken together, source selection method and the covariates accounted for approximately 53 per cent of the variance in buying team size (Adjusted $R^2 = 0.525$, $n = 116$). Table VI summarizes the results of the tests of hypotheses.

One-way analysis of CPARS ratings by source selection method

Source	Group means		df	SS	MS	F	p
	LPTA	TO					
Source selection method	3.64	4.15	1	2.47	2.47	4.33	0.041*
Value ^{a^}	\$26,300,000	\$79,900,000	1	0.41	0.41	0.71	0.402
Residual			66	37.75	0.57		
Total			68	41.86	0.62		

Notes: Significance level $* < 0.05$; ^{a^}Means are based on observations used in this ANCOVA ($n = 69$), and do not match the means for the entire data set (Table II, $n = 124$); [^]Means shown are untransformed, while the logarithmically-transformed variable (lnvalue) was used for the ANCOVA

Table IV.
ANCOVA results –
supplier performance

Discussion

Two fundamental approaches to the evaluation of competing suppliers' proposals include a LPTA method and a TO method. Each method has advantages and disadvantages; but, heretofore, research has not explored the links between source selection methods and key procurement outcomes. Exploring the differences is important because buyers may not enable the co-creation of the most value if an inappropriate source selection method is used. Additionally, exigencies could nudge buyers toward emphasizing price such as the:

- increasing preference for e-commerce by B2B millennial buyers (UPS, 2015);
- use of electronic reverse auctions (Hawkins *et al.*, 2009); and
- organizations' low-price purchasing policies (Töytäri *et al.*, 2015).

Managerial implications

Price still does not contain all of the information that a buyer will need to make a purchasing decision for many industrial goods and services. Value determinations will need to consider non-price factors as well. Indicators of value explored herein included PLT, supplier performance and transaction costs.

The multiple regression showed that average PLT was approximately 36 per cent longer[1] for the TO supplier selection method than for source selections using an LPTA approach. This

One-way analysis of buying team size by source selection method

Source	Buying team size Group mean		df	SS	MS	F	p
	LPTA	TO					
Source selection method	3.69	11.22	1	3.371	3.371	9.860	0.002***
Value ^{a^}	\$2,337,155	\$54,900,000	1	11.489	11.489	33.610	0.000***
Number of evaluation factors*	2.12	3.04	1	0.105	0.105	0.310	0.581
Number of offers ^{a^}	3.73	4.94	1	2.687	2.687	7.860	0.006***
Residual			111	37.946	0.342		
Total			115	82.764	0.720		

Notes: Significance level *** < 0.01; ** < 0.05; * < 0.10; ^aMeans are based on observations used in this ANCOVA (n = 116), and do not match the means for the entire data set (Table II, n = 124); [^]Means are untransformed, while the logarithmically-transformed variables (lnvalue and lnnumoffers) were used for the ANCOVA

Table V.
ANCOVA results –
transaction costs

Hypothesis	Description	Results
1	A TO source selection method will have longer PLT than will an LPTA source selection method	Supported
2	Supplier performance will be higher when the supplier was selected via a TO, rather than an LPTA, source selection method	Supported
3	The size of the buying team will be greater for source selections using the TO method versus the LPTA method	Supported

Table VI.
Results of
hypotheses

quantified difference in lead times should be useful for those buying activities deciding on the appropriate source selection method and developing commensurate procurement milestones.

Additionally, while buying teams want flexibility to pay a greater price for increased performance, they should also consider the transaction costs and possible inventory costs associated with prolonging the proposal evaluations. Understanding suppliers' offers of greater benefits than the minimum requirements consumes time, which drives labor costs. As greater cycle time can increase pipeline inventory, and considering that longer planning cycles increase uncertainty, and thus forecast error, the safety stock could increase. Specifically, PLT can affect the amount of inventory in at least two meaningful ways – cycle stock and safety stock (Emmett and Granville, 2007). Total lead time – the time from the identification of a customer's need to the delivery of the product to the customer – includes PLT in cases in which the item or material of it must be sourced from a supplier. The longer the total lead time, the greater the amount of cycle stock that is in transit between and in-work among the entities in the supply chain. PLT can also affect forecast accuracy, which, in turn, has an effect on safety stock (Emmett and Granville, 2007). The longer the total lead time, the longer the forecasting planning horizon. As the planning horizon increases, forecast error increases. As forecast error increases, uncertainty (i.e. variability of demand during lead time) increases. As safety stock is determined by the variability, more safety stock inventory will be required to buffer against that increased uncertainty. Thus, during source selection, these transaction costs should be weighed against any surplus benefits offered by suppliers – in addition to any associated increase in offered price.

Turning back to information processing theory, buyers using the TO source selection method should seek innovative ways to either:

- increase the information processing capacity of evaluating non-price factors; or
- reduce the amount of information needed.

Speeding up the TO evaluation process will give buyers less of a reason to select an inappropriate source selection method for the sake of awarding a contract sooner (e.g. LPTA), a common occurrence in government contracting (Hawkins *et al.*, 2015). The following four ideas could prove instrumental. First, buyers could define predetermined performance thresholds for each evaluation factor and their associated evaluation ratings. Examples include the DoD's new value-adjusted technically evaluated price (VATEP) source selection method (Lohfeld, 2016), and the quality-infused price (QIP) method (Finkenstadt and Hawkins, 2016) for more subjective services and for past performance evaluations. The QIP method can save lead time by mitigating the amount of required information in the offeror's past performance volume of their proposal and by effectively crowd sourcing past performance ratings (Finkenstadt and Hawkins, 2016). This idea is particularly germane to services, in which defining precise needs is difficult and requires substantial amounts of information. For services, supplier reputation serves as a useful proxy for the buyer's uncertainty of capability and reliability, thereby reducing the amount of information needed. Second, buyers could require that offerors, in their proposals, quantify the costs and benefits of any components of their offer claimed to surpass the minimum requirements. Third, acquisition teams could use a secured information technology system to: receive proposals, evaluate proposals as a virtual team, meet virtually to discuss evaluations and present results to the reviewers and to the source selection authority. Fourth, agencies could establish a permanent source selection organization that helps conduct source selections for the enterprise.

While source selection method affects PLT, the number of evaluation factors is also quite impactful. Specifically, the more factors that are included in the request for proposals, the

more time it takes to evaluate them properly and award a contract. The results show an increase of one evaluation factor increases PLT by 28 per cent. While it may be common sense that more evaluation factors require more assessment time, this research quantifies the effect. This finding raises a question about how many evaluation factors are optimal. In other words: Is there a tipping point at which the number of evaluation factors included in the supplier selection significantly affects PLT? Finding the answer to this question would help sourcing teams plan their procurements accordingly, or at least plan for the extra time required to assess many evaluation factors. Regardless, this result demonstrates the importance of including only the most important evaluation criteria in a request for proposal to be as efficient as possible yet still be able to distinguish between offers of value in a meaningful way.

Further, the number of offers received also affects PLT. More offers require more time to properly evaluate before awarding a contract. The results show that a 10 per cent increase in the number of offers results in a 1.9 per cent increase in PLT. This increase in PLT appears to be small. However, consider that one more proposal added to a set of ten received would add six days of PLT (1.9 per cent of 290 days of average PLT). Prior research shows that an average source selection costs \$238,045 in transaction costs (Hawkins *et al.*, 2017) or \$821 per day – nearly \$5,000 of added transaction costs. Across the tens of thousands of formal source selections conducted each year by the US Government, a seemingly small adjustment makes a big impact.

Turning to supplier performance, this research offers additional insight. The supplier performance scores (e.g. CPARS) were, on average, 14 per cent higher for TO supplier selections when compared to LPTA supplier selections. Thus, sourcing teams, in allowing TOs of higher prices for higher performance, are indeed reaping the anticipated benefits, and this research reveals the quantified extent of improved performance. It also means that suppliers are delivering on promises of additional value. Therefore, in situations in which supplier performance is paramount, sourcing teams should consider, following diligent proposal scrutiny, paying a premium sacrifice (i.e. price) for extra benefits (i.e. supplier performance). It also means that a low-bidder source selection method should not be considered the same as a TO method, and buying teams can expect different results. In terms of information processing theory, with better performance comes less defects and less administrative burden documenting, communicating and rectifying failures. Hence, the amount of information to be processed is reduced.

The findings suggest that the added value is not cost-free. With regard to transaction costs, more people are typically assigned to evaluate proposals and to assess value using the TO method than when using the LPTA method. On average, there was approximately three times the number of people for purchases using TO source selections than purchases using LPTA source selections. Clearly, TO source selections result in higher transaction costs, and those costs should be considered in conjunction with PLT and supplier performance when deciding which source selection method will provide the most value for the organization.

Study limitations and areas for further research

This study is not without limitations. First, the archival data, while rich and more objective than survey data, were only available from a sample of buying locations. And, within those locations, only a subset of complete contract files were sampled because of time and resource constraints. Second, the data were collected in the context of a not-for-profit buyer. Because of a need for public sector accountability and transparency, sourcing processes in this sector are heavily regulated and could consume more time than do for-profit sector counterparts – even though for-profit and not-for-profit sector sourcing have been found to

be more similar than dissimilar (Hawkins *et al.*, 2011). Third, while managerial implications to inventory costs associated with longer PLTs are drawn, the sample consisted of services, as well as products. Nonetheless, not all services are purely intangible; often they involve goods that must be inventoried. Additionally, several services in the sample are highly tangible and behave more like products than services (e.g. equipment repair that entail spare parts inventory). Contracts for maintenance services, logistics and products (i.e. those likely involving inventory) accounted for only 43 per cent of the sample.

Future research should examine whether the additional transaction costs of evaluating proposals and assessing net value are worth the improvements in supplier performance. Clearly, a more rigorous evaluation that considers evaluation factors other than low price will consume more time and effort, but the question remains whether those transaction costs are worth it in terms of yielding surplus value. Additionally, this research examined PLT and supplier performance as key indicators of buyer value. Future research could explore the effects of source selection method on other aspects of value such as competitive advantage and financial performance. Future research could also seek to confirm whether the findings herein also pertain to a for-profit context. Finally, the literature shows that procurement research heretofore has largely ignored value as a key dependent variable. There may be great opportunity for enhancing our understanding of procurement phenomenon and buyer–supplier relations by prioritizing the investigation of value.

Note

1. Log-transformed variables are interpreted in the text. In this case, 36 per cent is the expected increase in PLT given a one-unit increase in source selection method, i.e. TO source selection ($e^{.310}$).

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Appendix

Effects of
source
selection
method

* PSC	Description	Count	(%)	Cumulative
1265	Fire control transmitting and receiving equipment	1	0.81	0.81
1356	Torpedo explosive components	1	0.81	1.61
1510	Aircraft, fixed wing	1	0.81	2.42
1680	Miscellaneous aircraft accessories components	2	1.61	4.03
1903	Destroyers	1	0.81	4.84
1905	Sub-chasers	1	0.81	5.65
1915	Cargo and tanker vessels	3	2.42	8.06
1940	Small craft	1	0.81	8.87
2010	Ship and boat propulsion components	2	1.61	10.48
2020	Rigging and rigging gear	1	0.81	11.29
2090	Miscellaneous ship and marine equipment	5	4.03	15.32
2330	Trailers	1	0.81	16.13
4140	Fans, air circulators and blower equipment	1	0.81	16.94
4920	Aircraft maintenance and repair shop equipment	1	0.81	17.74
5340	Hardware, commercial	1	0.81	18.55
5821	Radio and TV equipment, airborne	1	0.81	19.35
6930	Operational training devices	2	1.61	20.97
7030	Software	5	4.03	25.00
7035	Computer support equipment	1	0.81	25.81
7050	Computer components	1	0.81	26.61
8470	Armor, personal	1	0.81	27.42
AC63	Research and development (R&D): electronics and communications equipment – advanced development	1	0.81	28.23
AC64	R&D: electronics and communications equipment – engineering development	1	0.81	29.03
AC65	R&D: electronics and communications equipment – operational system development	1	0.81	29.84
AC66	R&D: electronics and communications equipment – management and support	1	0.81	30.65
AD24	R&D: defense services – engineering development	1	0.81	31.45
AD91	R&D: other defense – basic research	1	0.81	32.26
AD94	R&D: other defense – engineering development	1	0.81	33.06
AJ11	R&D: physical sciences – basic research	1	0.81	33.87
D301	Automatic data processing facility management	1	0.81	34.68
D308	Automatic data processing programming services	1	0.81	35.48
D310	Automatic data processing backup and security services	1	0.81	36.29
D399	Other computer services	8	6.45	42.74
G001	Care of remains and/or funeral services	1	0.81	43.55
G002	Chaplain services	1	0.81	44.35
J015	Maintenance and repair of aircraft	3	2.42	46.77
J019	Maintenance and repair of ships, small craft, pontoons and floating docks	5	4.03	50.81
J020	Maintenance and repair of ship and marine equipment	1	0.81	51.61
J058	Maintenance and repair of communication, detection and coherent radiation equipment	1	0.81	52.42
J059	Maintenance and repair of electrical and electronic equipment	4	3.23	55.65
J063	Maintenance and repair of alarm, signal and security detection systems	1	0.81	56.45
J069	Maintenance and repair of training aids and devices	1	0.81	57.26

(continued)

Table AI.
Types of goods and services

JDAL	* PSC	Description	Count	(%)	Cumulative
1,1	J070	Maintenance and repair of automatic data processing equipment, software, supplies and support equipment	2	1.61	58.87
	L018	Technical representative services – space vehicles	1	0.81	59.68
	L019	Technical representative services – ships, small craft, pontoons and floating docks	1	0.81	60.48
	L2020	Technical representative services – ship and marine equipment	1	0.81	61.29
	M127	Operation of government-owned-electronic and communications systems facilities	2	1.61	63.71
	M181	Operation of government-owned-R&D GOCO facilities	1	0.81	64.52
	N058	Installation of communication, detection and coherent radiation equipment	1	0.81	65.32
	N059	Installation of electrical and electronic equipment	1	0.81	66.13
	Q503	Medical service – Dentistry	1	0.81	66.94
	Q999	Other medical services	2	1.61	68.55
	R408	Program management/support services	5	4.03	72.58
	R414	Systems engineering services	1	0.81	73.39
	R425	Engineering and technical services	8	6.45	79.84
	R426	Communications services	2	1.61	81.45
	R699	Other administrative support services	2	1.61	83.06
	R706	Logistics support services	1	0.81	83.87
	R799	Other management support services	1	0.81	84.68
	S201	Custodial, janitorial services	1	0.81	85.48
	S208	Landscaping/grounds – keeping services	1	0.81	86.29
	S209	Laundry and dry cleaning services	1	0.81	87.10
	S216	Facilities operations support services	1	0.81	87.90
	U005	Tuition, registration and membership fees	5	4.03	91.94
	U008	Training/curriculum development	1	0.81	92.74
	U009	Education services	1	0.81	93.55
	U013	Education/training – combat	1	0.81	94.35
	V121	Air charter for things	1	0.81	95.16
	V227	Navigational aid and pilotage services	1	0.81	95.97
	V999	Other transportation, travel and relocation services	2	1.61	97.58
	W084	Lease or rental of clothing, individual equipment	1	0.81	98.39
	Y239	Construction of electric power generation-Other	1	0.81	99.19
	Z299	Maintenance, repair or alteration of all other non-building facilities	1	0.81	100.00
	TOTAL		124		

Table AI. Note: *PSC = Product or service code

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