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Strategic sourcing and corporate social responsibility: Aligning a healthcare organization's strategic objectives☆

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ABSTRACT

Strategic sourcing has long been utilized by organizations to maximize budget efficiency. The process includes a spend analysis, which historically has been performed by identifying the commodities and services purchased that resulted in the greatest spend, and establishing contracts with suppliers for these items in an effort to decrease the overall price through quantity discounts. This process restricts the data used in the spend analysis process to basic transactional information, and has not considered corporate social responsibility objectives as part of the strategic sourcing process. This paper modifies an existing spend analysis process framework, and applies the framework in a case study that uses additional data points to identify opportunities that allow an organization to simultaneously achieve both strategic purchasing and social responsibility objectives. The case study uses healthcare purchasing data from eight Department of Veterans Affairs medical centers. The goal of the model generated using regression analysis in the case study is to determine the buy characteristics that are most likely to generate mandated savings within the medical centers, in conjunction with achieving sustainability goals. The extensions of the regression model were examined to determine how collaborative buyer/supplier relationships can achieve organizational strategic objectives.

1. Introduction

Purchasing practices are a crucial component of an organization's success, yet in the healthcare industry, practices are immature and often overlooked in a healthcare organization's strategic vision (Nachtmann and Pohl, 2009). In 2014, total healthcare expenditures in the United States exceeded $3.0 trillion (Centers for Medicare & Medicaid Services, 2015) and since 1940, the annual increase in healthcare expenditures has remained at roughly 4% per year with no indication that the rate will decrease in the future (Gibson, 1980; Newhouse, 1993; Sampson et al., 2015). Many healthcare facilities do not employ proven purchasing practices used in other industries to increase efficiency while decreasing total expenditures (Schneller and Smeltzer, 2006). One aspect of purchasing is strategic sourcing, where buyers form relationships with suppliers that result in cost savings through logistical and purchasing efficiencies. Due in part to the large number of hospitals that outsource some or all of the purchasing function (Burns and Lee, 2008; Carey and Dor, 2007; Makowski and Clauß, 2011), there is a lack of research focusing on the role of strategic sourcing of commodities in healthcare. Very few studies examine the role of acquisition in a healthcare facility's strategic vision or the use of strategic sourcing as a method to expand sustainable purchasing practices. Current healthcare literature explores sustainable practices as they relate to patient treatment, a healthcare facility's primary function (Brandão et al., 2012; Russo, 2014). Sustainability studies of efforts in industries outside of healthcare examine the effects of sustainable practices, but do not propose strategies to effectively target suppliers that allow the organization to meet sustainability initiatives, either environmental or social.

The strategic sourcing process begins by analyzing historical spend. The spend analysis is a critical tool used to identify items appropriate for strategic purchasing or leveraged purchasing, and has been used to generate cost savings for organizations of up to 25% (Pandit and Marmanis, 2008). The process begins with collecting historical spend data, sometimes from multiple sources. The data is scrubbed, classified, and analyzed to select items or services that are best suited to meet an organization's strategic purchasing goals (Limberakis, 2012). A spend analysis allows the organization to classify the types of spending and prioritize sourcing initiatives; however, even when an organization is using a framework, oftentimes organizations will ignore spend analysis data and begin strategically sourcing items based on preference (Cox, 2015).

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The spend analysis process was described in detail in an Aberdeen Group whitepaper in 2004 (Aberdeen Group, 2004). Early applications of strategic sourcing encouraged companies to use the spend analysis process to identify immediate opportunities, instances where a single supplier was utilized for multiple purchases, and the potential for purchase consolidation existed (Greenfield, 2005). Some spend analyses evolved to include a compliance metric to ensure purchases were made in accordance with existing organization purchasing edicts, such as using specified contracts or suppliers (Saha, 2007). Expanding on this concept, authors from IBM described how cluster analysis could be used to not only identify non-compliance within a purchasing department, but allow managers to identify which departments and purchasing categories would provide the greatest return on investment if total compliance was observed (Chowdhary et al., 2011). In 2012, Limberakis published a trade article that provided a slightly modified version of the process described by the Aberdeen Group (2004), adding a first and last step to define the scope of the analysis and a path forward using the results of the analysis. Providers of commercial spend analysis solutions have embraced the need to measure compliance, but generally have not changed the process of analyzing spend described by the Aberdeen Group in 2004 (Maurides, 2015; ProcurePort eSourcing OnDemand, 2014).

Academic literature has not extensively examined how to optimize spend analysis, or determined if existing spend analysis processes could be changed to better accomplish organizational goals. This paper will propose a modified strategic sourcing spend analysis framework that allows an organization to align its strategic purchasing and sustainability goals. A case study utilizing the framework will be presented that uses spend data from an eight-hospital system. The purchasing data used was restricted to healthcare commodities available from multiple suppliers. The authors believe that establishing collaborative relationships with suppliers to realize strategic sourcing and sustainability goals could decrease overall spend within the logistics department while decreasing supplier risk. The research questions that this paper seeks to answer are:

1. *Can historical healthcare purchasing data be used to optimize strategic sourcing efforts and allow a facility to determine the best avenues to achieve its sustainability goals?*
2. *Can the methods utilized above be used in industries other than health care?*

This paper is organized as follows: A literature review will provide an overview of strategic sourcing, supplier/buyer relationships, and sustainability. The literature reviewed describes processes used outside of healthcare due to the gap that exists with respect to healthcare purchasing, strategic purchasing, or sustainable purchasing initiatives. An alternate spend analysis framework will be proposed that incorporates these two concepts, and the framework will be applied to a case study using healthcare purchasing data obtained from a group of eight medical centers.

2. Literature review

2.1. Strategic purchasing defined

Strategic purchasing was introduced as a practice used to secure items crucial to an organization's daily operations where, due to the abundance of the items and the likelihood of a continued requirement, would benefit from the establishment of a centralized contract to purchase the item for an organization (Kraljic, 1983). Strategic purchasing differs from leveraged buying because price considerations may not be the primary focus of negotiators, even when large quantities of products are required by the purchaser. An organization's strategic purchasing strategy will consider the total transactional costs as well as the total life-cycle costs of the product, to include efficiencies outside of the purchasing process that may be provided by the supplier (Farmer, 1981). Strong relationships with fewer suppliers may decrease overall costs associated with supply chain management, beyond the transactional cost of the product (Spekman et al., 1999). Best strategic purchasing practices move beyond requesting discounted pricing for the supplies or services being acquired, since this practice can damage the burgeoning buyer-supplier relationship, eliminating all benefits of forging strategic relationships with suppliers (Anderson and Katz, 1998; Rossetti and Choi, 2005). The critical examination of the desired relationship and potential benefits stemming from this relationship will determine how a supplier can enhance its supply chain processes and its competitive position (Eltantawy et al., 2014; Knoppen and Sáenz, 2015).

2.2. The buyer-supplier relationship

A buyer might first consider a strategic purchasing relationship when trying to streamline operations when considering outsourcing services. Gottfredson et al. (2005) examined companies that had established strategic purchasing relationships with suppliers and found that these relationships allowed the buyers to enhance core operations, while strengthening their market share, since strategic suppliers had the capability to manage non-critical portions of the business. Supplier relationships can streamline purchasing and logistical operations by reducing transactional purchasing costs, costs associated with the ordering process, and delivery costs, showing that more sophisticated relationships between the buyer and supplier can result in efficiencies within the buyer's organization (Andersen et al., 2016; Jap, 1999; Lee et al., 2011). Conversely, a supplier can also improve its operations based on feedback provided by buyers, allowing the supplier to provide higher quality supplies and services (Flint et al., 2008). A relationship between the buyer and supplier may develop from repeated interactions during previous trade (Gulati, 1995) or it may result from the supplier's inclusion on strategic teams within the buyer's organization (Andersen et al., 2016; Lacoste and Johnsen, 2015). It is unlikely that the relationship will develop solely as a result of negotiations being held for a discrete, or transactional type of purchase (Dwyer et al., 1987).

A critical requirement of any collaborative relationship is establishing the relationship early in the requirement definition process, as this is key to finding efficiencies that lie outside of the procurement process (Saunders et al., 2015). It is also important to ensure that prospective suppliers have the capability to become a strategic partner (Ellram and Carr, 1994; Spekman et al., 1999) and that the prospective supplier views the contemplated relationship as strategic (Schiele, 2012). Each partner must express their goals and objectives during the initial stages of a collaborative relationship, and if these change, be willing to discuss the new priorities with the other party (Barratt and Oliveira, 2001; Dwyer et al., 1987). Successful relationships also require the buyer to define the supplier's role clearly prior to the commencement of the relationship, and not expand the supplier's role without discussions during the relationship (Ueltschy Murfield et al., 2016). The incentive to establish a collaborative relationship is not limited to the buyer's desire to transform purchasing processes; suppliers who enter into these relationships have realized that there is limited growth in sales driven by tenders, and to increase market share and perceived value, a supplier will foster and encourage collaborative relationships (Dyer and Singh, 1998). Both the buyer and supplier must trust the other party (Morgan and Hunt, 1994). Attributes such as honesty, communication, and a desire to achieve mutual goals decrease the probability that one party will act in an opportunistic manner, and allows for an equitable balance of power between the collaborators (Gundlach et al., 1995; Jap, 1999; Jap and Ganesan, 2000). True collaboration results in a team mentality, and success is measured in terms of the end product, not by successes that enhance the business operations of one party that do not support the final objective (Ireland and Bruce, 2000).

The literature has detailed instances where both small and large business suppliers have successfully developed innovations while working on collaborative teams within the buyer's organization that met the buyer's objectives (Andersen et al., 2016; Jap, 1999; Lacoste and Johnsen, 2015). Lacoste and Johnsen (2015) described a buyer-supplier relationship that had transformed from a relationship based on tenders, where lowest cost was the priority for the buyer, to one that required the supplier to become a part of the logistics team. The suppliers made changes to their product, and while the cost of the new product exceeded the original, the buyer realized savings due to decreased transportation costs. Similarly, Andersen et al. (2016) described a buyer-supplier collaboration that allowed the supplier to assist in the redesign of one of the buyer's products. The buyer is also motivated to help the supplier meet contractual objectives vice terminating the contract for non-performance, but this may stem from the perceived financial cost of finding a new supplier (Andersen et al., 2016; Dwyer et al., 1987; Lacoste and Johnsen, 2015).

Decreasing procurement risk will help strengthen buyer/supplier relationships. For example, providing a supplier an accurate forecast of its requirements, through the establishment of a standing order, will decrease the risk to the supplier by allowing the supplier to plan expenditures more accurately, decrease administration costs for both parties, and establish a mutual dependency between the two parties (Ahola et al., 2008; Laneros and Monckza, 1989). A manufacturer can use the forecast information to adjust production and prevent overruns or shortfalls (Stank et al., 1999). Collaborations can be used to increase the quality of the supplier's product or service, or improve delivery schedules (Vereecke and Muylle, 2006). Handley and Benton (2009) found that suppliers provided higher quality results when acting as a partner in a collaborative relationship, which ultimately results in the buyer's ability to produce a better product or service. A collaborative partnership is more likely to produce beneficial innovative solutions than either party acting alone (Roy et al., 2004; Wiengarten et al., 2013).

2.3. Sustainability initiatives and purchasing

Long-term partnerships can also help organizations achieve sustainability goals (Elkington, 1998). Effective sustainability initiatives that incorporate the “triple bottom line,” that is including environmental, social, and economic considerations into the sustainability plan, can improve an organization's image with its customers, improving overall economic performance (Carter and Jennings, 2004; Carter and Rogers, 2008; Ellen et al., 2006). Executing a sustainability strategy can be difficult, and organizations may have trouble identifying opportunities that align with stated goals and initiatives (Maignan et al., 2002; Porter and Kramer, 2006). Leadership support for the sustainability initiative(s) is a crucial component of success, and leadership must insure that employees receive proper instruction in order to realize sustainability goals (Blount and Hill, 2015; Pagell and Wu, 2009). Strategic sourcing initiatives incorporated into the organization's strategic goals that have high-level champions are more successful than initiatives that lack upper management buy-in (Carr and Smeltzer, 1997; Ellram and Carr, 1994; Lee et al., 2011). A similar conclusion was reached when surveying companies with established sustainability programs (Jong and Meer, 2015).

The incorporation of corporate social responsibility purchasing initiatives as part of an organization's strategic plan is typically examined with respect to the benefits of sustainability and has been studied extensively (Carter and Jennings, 2004; Carter and Rogers, 2008; van Hoek and Johnson, 2010; Pagell and Wu, 2009; Porter and Kramer, 2006). Previous studies have shown that like strategic purchasing, sustainability initiatives that are incorporated into an organization's strategic goals are most effective (Elkington, 1998; van Hoek and Johnson, 2010), and the benefits to successful sustainability initiatives can outweigh additional costs associated with the initiatives (Carter and Jennings, 2002). Maignan et al. (2002) made recommendations on effectively using social responsibility as a consideration in purchasing, and how purchasing could help an organization to meet sustainability goals. Porter and Kramer (2006) examined sustainability implications on retail strategies, in the context of profitability that results from stocking socially and environmentally responsible items, or through the purchase of these items for use in manufacturing, but did not examine the process to identify the suppliers that allow organizations to meet sustainability goals. Ciliberti et al. (2008) and Pagell and Wu (2009) examined sustainability initiatives with respect to supply chain management, but again, specific practices to identify and increase the role of target companies were not explored as they were in this study.

While sustainability has been incorporated into overall sourcing strategies, to date, a study that examines sustainability initiatives through a strategic purchasing lens has not been published, although Quarshie et al. (2016) recommends pursuing sustainability through strategic relationships instead of relying on discrete purchases. Aligning sustainability efforts in the purchasing arena and strategic sourcing efforts is a logical extension of current practice, becoming an additional factor in the portfolio review or spend analysis processes. Additionally, the focus of strategic sourcing in private industry has shifted from to obtaining the best pricing to obtaining the best overall value for an organization (Rossetti and Choi, 2005), and Montabon et al. (2016) suggests prioritizing sustainability over economic considerations to achieve greatest success. The departure from using tenders to achieve profit goals to a holistic view of the organization and its impact on the environment, both ecologically and socially, presents an opportunity for businesses to identify partners in strategic relationships that meet sustainability and strategic purchasing goals.

3. Proposed framework

Much of the current strategic sourcing literature focuses on supplier selection which occurs at the end of the strategic sourcing process, and a common research goal is the design of models that will result in efficient supplier selection (Anderson and Woolley, 2002; Degraeve et al., 2000; Rosenthal et al., 1995; Sandholm et al., 2006; Zhang and Chen, 2013). Supplier evaluation models have been used to achieve cost savings while also streamlining the purchasing process (Weber et al., 1991). The models examine the decision process as it relates to selecting suppliers (De Boer et al., 2001). In determining the best model for supplier selection, entities in the private sector consider the quantity of required items, ordering schedule, price, the number of suppliers to ultimately source products from, the advantages and disadvantages of bundling orders, and quality (Rosenthal et al., 1995); interestingly, many of these variables are also examined during a spend analysis. Early models examined efficiencies gained after soliciting offers (Aissaoui et al., 2007), while more recent models have explored how changing business needs could have an impact on the supplier selection process (Zhang and Chen, 2013; Zhang et al., 2013). Sparse research has been conducted focused on the spend analysis process, a required first step of strategic sourcing processes (Aberdeen Group, 2004).

The modified spend analysis framework proposed in this study expands the role of the spend analysis to encompass the alignment of strategic sourcing and sustainability strategies. The framework also allows an organization to identify sustainability and sourcing best practices when examining purchasing data, especially when purchases are made for different sites or through a decentralized purchasing process. The authors make the assumption that sustainability and strategic purchasing goals are determined prior to the spend analysis, and the spend analysis is executed to support these goals.

This framework requires the organization to be able to obtain detailed transactional data that includes supplier profiles in addition to the transaction cost, supplies purchased, and delivery information. If

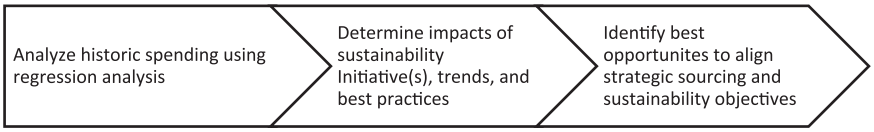

Fig. 1. Proposed modification to spend analysis process described by Limberakis (2012).

purchases are made on a decentralized basis, data identifying the purchasing office should also be included. Digital data is ideal, especially if multiple databases will be merged to include all data points required by the user (Rafati and Poels, 2015). The proposed framework employs regression analysis to allow better insight into the effect of sustainability initiatives and acquisition planning decisions on purchasing (Fig. 1). The framework was developed using transactional savings as the dependent variable, but other dependent variables could be selected, provided that the database includes the desired variable(s). Savings was selected for this framework because strategic sourcing efforts are undertaken to realize cost savings (Anderson and Katz, 1998; Chan and Chin, 2007; Hesping and Schiele, 2015). This varies from private industry strategic sourcing goals, but the framework can be modified to accommodate different analytical objectives.

The proposed framework changes the spend analysis step in the process described by Limberakis (2012) to allow examination of sustainability initiatives. Regression analysis is used to identify successful execution of sustainability purchasing objectives, while also identifying potential strategic sourcing targets. The regression's independent variables are selected based on an organization's strategic goals and operating environment. The regression analysis will allow the organization to assess the impact of strategic objectives on the dependent variable. The results of the regression analysis can be used to identify product categories that maximize savings when also achieving sustainability initiatives, or identify best practices. For example, an organization may find that a particular category of items, e.g. women-owned small businesses (WOSB), an example of an industry sustainability goal (Carter and Jennings, 2002, 2004), provide the greatest savings to the organization in a certain spend category. By identifying appropriate items to strategically purchase in that category, the company could prepare a solicitation for WOSBs, inviting the suppliers to propose collaborative solutions to provide the needed supplies or services. The solicitation would explain that the objective of the buyer/supplier relationship would extend beyond the purchasing process, that the collaboration would examine the entire usage of the supply or service within the buyer's footprint to spur innovations to find efficiencies within the supply chain, moving beyond realizing cost savings at the point of sale.

4. Case study

The Department of Veterans Affairs treats almost 9 million Veterans each year in more than 1700 medical treatment facilities located in the United States and its territories (Veterans Health Administration, 2014). In Fiscal Year 2013, the largest spend category attributed to the Department of Veterans Affairs was Medical, Dental, and Veterinary Equipment and Supplies, representing more than 75% of award actions in that fiscal year, with a total spend of more than $7B (General Services Administration, 2014). The purchases ranged from high-tech medical equipment, such as magnetic resonance imaging (MRI) instruments, to inventory items purchased on a regular basis for individual medical centers. This product category holds hundreds of opportunities for strategic sourcing within the Veterans Health Administration, and the proposed model allows the agency to identify the best candidates for strategic sourcing, garnering the greatest possible savings.

The historical spend data of eight Veterans Affairs Medical Centers (VAMC) located in Virginia, North Carolina, and West Virginia (Table 1), that make up the Veterans Integrated Service Network 6 (VISN-6), was input into the proposed framework. The study area was determined on a regional basis rather than a national basis because, as discussed by T. Zhang et al. (2013), certain commodities and services are well-suited for standardization across the entire organization and other requirements are specific to localities. The authors feel that this decision is appropriate due to regional collaboration in treating a similar patient population, and the regional utilization of a single, centralized purchasing office. The eight medical centers are of varying sizes and complexities. The Department of Veterans Affairs determines hospital complexity by considering: the patient population; the complexity of services offered by the medical center; and teaching and research programs at each medical center (Goolsby, 2012). The complexity levels used to classify Department of Veterans Affairs Medical Centers are 1A, 1B, 1C, 2, and 3, with 1A being the most complex (Goolsby, 2012), as shown in Table 1.

Table 1
Location and complexity of VISN-6 Medical Centers.

Medical Center	Location	Complexity
Charles George VAMC	Asheville, NC	1C
Beckley VAMC	Beckley, WV	3
Durham VAMC	Durham, NC	1A
Fayetteville VAMC	Fayetteville, NC	2
Hampton VAMC	Hampton, VA	2
Hunter Holmes McGuire VAMC	Richmond, VA	1A
Salem VAMC	Salem, VA	1C
W.G. (Bill) Hefner VAMC	Salisbury, NC	1C

Spend data reported to the Federal Procurement Data System-Next Generation (FPDS-NG) was examined to determine spend patterns and to identify potential supply or service groups that would result in strategic sourcing opportunities. The reports generated were sorted using Product Service Codes (PSCs), numerical codes used by the federal government to describe spend categories. The PSC has successfully been used to identify high-spend commodity and service categories when analyzing other government agencies' spend (Cook et al., 2004; Moore et al., 2011). In VISN-6, during the study period that began on January 1, 2013 and ended on January 17, 2014, medical and scientific product purchases represented almost 50% of the total reported spend, and 63% of the total number of purchases (Table 2). The total number of transactions in this subset exceeds 20,000 and the product categories of the items purchased are detailed in Table 3. The next largest spend category, medical care services, was attributable to 12% of dollars spent and almost 7% of all procurement (Table 2). The next three highest spend categories were maintenance, repair, and alteration of facilities; construction of structures and facilities; and Architect and Engineering services. The FPDS-NG data retrieval tool was used to further analyze VISN-6 medical supply spending. VISN-6 is beginning to analyze opportunities for strategic sourcing and recognizes that a primary challenge to VISN-6 will be determining which of the 20,000 transactions reported to FPDS-NG, plus the numerous transactions made outside of the purchasing department and not reported to FPDS-NG, will result in the greatest cost savings to the region.

Procurement history for the seven medical centers was obtained by the authors through a Freedom of Information Act Request, request number 14-03782-F. The information requested represented all purchases made through the region's contracting office for medical, dental, and veterinary equipment and supplies, as well as instruments and laboratory equipment, from January 1, 2013 through January 17,

Table 2
VISN-6 Top Spend Categories from FPDS.gov. Services do not include Research and Development expenditures.

Spend Category	Total Actions	% Total Actions	Total Dollars	% Total Dollars
Medical and scientific products	21111	63.6%	$280,614,079.84	49.2%
Medical Services	2286	6.9%	$71,302,593.28	12.5%
Maintenance, repair, and alteration of facilities	336	1.0%	$45,829,391.27	8.0%
Construction of structures and facilities	122	0.4%	$28,456,907.51	5.0%
Architect and Engineering services	169	0.5%	$25,774,461.67	4.5%

2014, that were reported to the Veterans Health Administrations (VHA) contract writing tool, eCMS. Due to procurement integrity regulations, information that could identify individual purchases was not included, such as the actual purchase price, the contract number, or the supplier's name. The data was restricted to the products described in Table 3, and only competed awards were analyzed. This reduced the overall number of awarded actions available for analysis, as discussed in Section 4.1.

Each record obtained included: the purchasing medical center's name; the product service code (PSC), describing the product categories described in Table 3; whether the action was competed (only 55% of all contract actions reported to FPDS-NG during the study period were competed); the contract value as a categorical variable; the percent savings of the transaction; the number of offers received; small business set-aside status; and a variable describing if the action was an open market action or if the product was purchased using a Federal Supply Schedule. The Department of Veterans Affairs has identified small business utilization as an agency sustainability goal. Table 4 summarizes each variable and discusses the basis for inclusion for each variable. The procurement cost (price paid) was classified into five categories based on publication requirements and required contracting methods as stated in the Federal Acquisition Regulations (Federal Acquisition Regulations, 2014). The percent savings (S_i) was derived prior to the release of the data using the actual ICE, and procurement cost, not proxies, and was calculated using the award value (C_i) and the Independent Government Estimate (IGE_i):

$$S_i = ((IGE_i - C_i) \div IGE_i) * 100 \quad (1)$$

The number of quotes received, the price paid, and subsequently, the percent savings are recorded in the contract file after a solicitation was published or multiple suppliers were contacted. Analysts review and verify the entries for accuracy on a weekly basis, and one of the focus areas is ensuring savings data has been entered correctly. Additionally, data verification of the data provided to the authors was performed using documentation in the contract files. The small business set-aside status and the venue in which the requirement was competed (i.e. via open market or restricted to federal supply schedule holders) represent acquisition planning decisions that are made based on strategic objectives. These two factors directly influence the number of suppliers that are eligible to submit a quotation in response to a solicitation. The medical center complexity affects the types of products purchased, since a more complex facility will be able to offer more specialty medical services than a less complex medical center and physician preference may influence purchases made for more complex hospitals (Montgomery and Schneller, 2007).

Prior to starting the analysis, the station identification data were reclassified by hospital complexity level (Table 1), and data describing non-competitive procurements were removed from the dataset. Non-competitive procurements were not considered because these actions are the least likely to result in savings to the medical center. The savings data is skewed towards zero: 1147 of the 1350 competitive actions had a savings rate of less than five percent (Fig. 2), illustrating the challenges purchasing departments experience when acquiring medical supplies (Schneller and Smeltzer, 2006).

4.1. Data analysis

The data obtained for this research was first analyzed using a binomial regression model to determine the probability that a difference in savings existed between purchases with realized savings between 0% and 10%, and those with realized savings greater than 10%. The cut-off value of 10% was selected based on the U.S. Government Accountability Office (GAO) recommendations to seek contractual opportunities that would result in at least 10% savings to the agency (Chaplain et al., 2013, 2012).

A linear regression model was then generated using transactions in which the savings realized were greater than or equal to 10%, with the intention of using this information to supplement regional spend analyses of the most-purchased medical center inventory items not already purchased through a strategically sourced contract vehicle. Forward and backward stepwise regression, which adds or subtracts each data category from the equation to find the best fit model, was used to help select the best model using the variables in Table 5. The linear regression analysis was restricted to purchases with realized savings greater than or equal to 10%.

All data was analyzed using R (R Development Core Team, 2014),

Table 3
VISN-6 Reported Spending, Groups 65 and 66.

Product Description	Total Actions	Total Dollars
Medical and Surgical Instruments, Equipment, and Supplies	13517	$134,730,289.56
Drugs and Biologicals	2866	$94,094,646.15
Hospital Furniture, Equipment, Utensils, And Supplies	2260	$23,558,786.20
In Vitro Diagnostic Substances, Reagents, Test Kits and Sets	1432	$13,381,106.01
Laboratory Equipment and Supplies	137	$3,149,864.65
Imaging Equipment and Supplies: Medical, Dental, Veterinary	57	$1,718,399.99
Dental Instruments, Equipment, And Supplies	52	$1,208,312.17
Ophthalmic Instruments, Equipment, And Supplies	31	$2,127,454.12
Chemical Analysis Instruments	30	$1,861,685.13
Hospital and Surgical Clothing and Related Special Purpose Items	25	$329,178.27
Surgical Dressing Materials	21	$389,708.43
Replenishable Field Medical Sets, Kits, And Outfits	9	$689,213.73
Optical Instruments, Test Equipment, Components and Accessories	8	$290,795.41
Drugs and Biologicals, Veterinary Use	1	$37,161.60

Table 4
Summary of data provided for study and basis for inclusion.

Post award data (as per model)	Data provided from agency	Basis of Inclusion
Independent Government Estimate	Proxy data submitted	The Independent Government Estimate (IGE), calculated when describing the requirement, and award value are used to calculate the per-transaction savings.
Number of responses received	Provided	Analyzing the number of responses received in response to a solicitation allows the agency to determine the effect that competition has, if any, on savings.
Marketplace	Provided	Solicitations can be distributed to all eligible suppliers (open market) or restricted to suppliers that have been awarded federal supply schedule (FSS) contracts. This variable is unique to federal procurement.
Small Business Set-aside status	Provided	The contracting officer may choose to restrict procurements to small businesses if competition is likely to meet agency social responsibility goals.
Award Value	Proxy data submitted	Used in regression analysis to determine potential best practices.
Contract Type	Provided	Used to ensure that single-award orders were analyzed.
Product or Service Description	Provided	Required to ensure that order data accurately reflected the desired product categories.
Site/Delivery Data	Provided	Can be used to identify differences in purchasing practices at hospitals of varying complexities or identify best practices that can be implemented throughout the organization

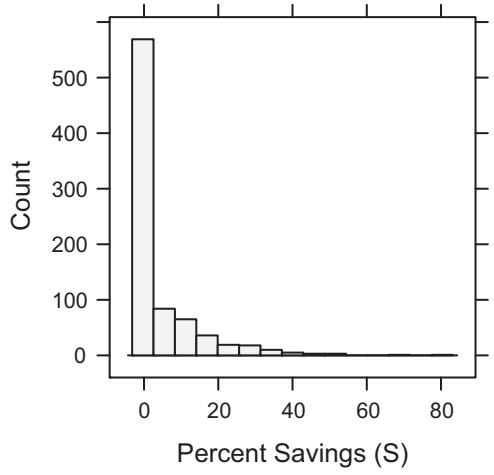

Fig. 2. Histogram of Savings data. Savings data is skewed towards zero; the calculated savings of 85% of purchases made during the study period was less than 5%.

Table 5
Model Variables.

Post-Award Data (Model)	Variable	Explanation
Independent Government Estimate/Award Value	S	% Savings (Dependent Variable)
Number of responses	N	Number of Offers Received
Small Business Set-aside status	SA1	No set aside requirement
	SA2	Small Business set aside
	SA3	Micro-Purchase (no set aside possible)
Marketplace	M1	Open Market Purchase
	M2	Federal Supply Schedule Purchase
Award Value	V1	Contract Value ≤$3000
	V2	Contract Value > $3000 and ≤ $15,000
	V3	Contract Value ≥ $15,000 and ≤ $25,000
	V4	Contract Value ≥ $25,000 and ≤ $150,000
	V5	Contract Value ≥ $150,000
Site/Delivery Data	C1	Medical Center Complexity 1A
	C2	Medical Center Complexity 1C
	C3	Medical Center Complexity 2
	C4	Medical Center Complexity 3

and the R packages CAR (Fox and Weisberg, 2011), AOD (Lesnoff and Lancelot, 2012) and LEAPS (Thomas Lumley using Fortran code by Alan Miller, 2009). A multiple linear regression model was generated using forward and backwards stepwise selection, where variables are added and then subtracted one at a time, and the Akaike Information Criterion score (AIC) was used to determine the best model. The variables used to create the model represented either a decision that is made in the acquisition process, e.g. if the buy is set aside for a small business, thereby meeting a sustainability purchasing goal, or a pre-determined factor, such as hospital complexity. Interactions between variables were also examined. The predictor variables used to create the regression model are summarized in Table 5. The model's dependent variable was the percent savings realized per transaction. The model's residuals were not normally distributed, so the dependent variable was transformed using a Box-Cox transformation (λ=−0.6177), and the regression was re-run using the transformed data.

4.2. Results

The binomial regression model generated to verify that purchases realizing savings that equaled or exceeded 10% are different from purchases with realized savings between 0% and 10% included two variables: cost and the number of offers (Table 6). Sixty percent of the original 814 purchases with realized savings greater than 0% were randomly selected to generate the model; the remaining purchase data was used to validate the model. The model's successful prediction rate was 85%, and the model is defined as:

$$Predicted\ Savings = \alpha + \beta_1 V + \beta_2 N \quad (2)$$

The multiple regression model derived, named MEDSAVE, contained four of the five predictor variables, accounted for 16% of the

Table 6
Binomial regression model on procurement savings as a function of final transaction value and number of offers. The predictive capability of the model was determined to be 85%. N=448.

Variable	Description	Parameter Estimate	Std. Error	P value
α	Intercept	0.87912	1.15758	0.44758
V1	Contract Value ≤$3000	Dummy Variable		
V2	Contract Value > $3000 and ≤ $15,000	−2.4172	1.16554	0.03809
V3	Contract Value ≥ $15,000 and ≤ $25,000	−3.24875	1.21711	0.0076
V4	Contract Value ≥ $25,000 and ≤ $150,000	−2.7985	1.18396	0.01809
V5	Contract Value ≥ $150,000	−3.42529	1.30642	0.00874
N	Number of Offers Received	0.17677	0.05879	0.00264

Table 7
MEDSAVE: Linear Multiple Regression on procurement savings as a function of the marketplace, set-aside status, medical center complexity, the number of offers, and interactions between set-aside status and the number of offers and the marketplace and medical center complexity. N=143; F=3.189; df=12,130; P=0.0005. Adjusted R^2=0.1561.

Variable	Description	Parameter Estimate	Std. Error	t value	P value
α	Intercept	1.359	0.016	85.388	< 2e−16
M1	Open Market Purchase	Dummy Variable			
M2	Federal Supply Schedule Purchase	−0.011	0.018	−0.594	0.553
SA1	No set aside requirement	Dummy Variable			
SA2	Small Business set aside	−0.038	0.034	−1.134	0.259
SA3	Micro-Purchase (no set aside possible)	−0.095	0.027	−3.527	0.0006
N	Number of Offers Received	0.001	0.003	0.506	0.614
C1	Medical Center Complexity 1A	Dummy Variable			
C2	Medical Center Complexity 1C	0.008	0.019	0.435	0.664
C3	Medical Center Complexity 2	0.049	0.021	2.36	0.020
C4	Medical Center Complexity 3	0.004	0.040	0.107	0.915
SA1:N	No set aside requirement: Number of offers	Dummy Variable			
SA2:N	Small Business set aside: Number of offers	0.026	0.013	2.079	0.040
SA3:N	Micro-Purchase (no set aside possible): Number of offers	0.016	0.009	1.872	0.063
M2:C1	Federal Supply Schedule Purchase: Medical Center Complexity 1A	Dummy Variable			
M2:C2	Federal Supply Schedule Purchase: Medical Center Complexity 1C	−0.048	0.026	−1.879	0.062
M2:C3	Federal Supply Schedule Purchase: Medical Center Complexity 2	−0.050	0.029	−1.696	0.092
M2:C4	Federal Supply Schedule Purchase: Medical Center Complexity 3	0.045	0.061	0.73	0.467

variance in savings, and is defined as:

$$S_{transformed} = \alpha + \beta_1 M + \beta_2 SA + \beta_3 N + \beta_4 C + \beta_5 (S:N) + \beta_6 (M:C) + \beta_7 \quad (3)$$

The model MEDSAVE's residuals were normally distributed, and the residual analysis was used to validate the assumptions of the model. The award value category was not a significant factor in the model and was discarded. Significant interactions were found to exist between the set-aside status and the number of offers, and between the marketplace and medical center complexity. The variance inflation factor (VIF) was calculated for the predictors. The VIF for the number of offers was 1.22, and the factors calculated for the remaining predictors, when adjusted for the degrees of freedom associated with each predictor and squared, were all less than 5 (Table 8), indicating that multi-collinearity did not influence the model.

The model MEDSAVE is depicted in Table 7. While this model will not be used for predictive spend analysis, MEDSAVE can be used to examine relationships between the decisions made in the acquisition phase and the ultimate savings realized, helping to identify best practices, reduce expenditures, and maximize small business award opportunities.

Competition for items in the Federal Supply Schedule (FSS) marketplace, as opposed to competing in the open market, resulted in a decreased savings, as did small business set-asides and micro-purchases, which cannot be set aside. The savings increase as the number of submitted quotes increase, and when compared to the most complex medical centers (complexity 1A), the lower complexity medical centers realize increased savings. When the interaction between the number of offers received and the number of offerors when only small businesses provided quotations (SA2: N), the projected savings increases as compared to the interaction between the dummy variable, acquisitions not reserved for small business, and the number of offers received (SA1: N). The same effect on savings is observed when the transaction cost does not exceed the micro-purchase threshold of $3,000.00 (SA3: N). A decrease is observed when centers of complexity 1C and 2 make FSS purchases (M2:C2 and M2:C3). Competition is used as a vehicle to realize savings in the purchasing process, as the tender process results in suppliers lowering prices to gain or maintain business (Lacoste and Johnsen, 2015). MEDSAVE supports this observation because the savings rate increases as the number of offers increases when considered alone and as part of an interaction term.

Table 8
Variance inflation factor for multiple regression model MEDSAVE. Categorical variables were adjusted for the degrees of freedom associated with each predictor and squared. All factors were determined to be acceptable and multi-collinearity is not suspected.

Variable	VIF
M	2.75
SA	3.44
N	1.23
C	1.94
SA:N	3.22
M:C	2.22

FSS orders, which are unique to federal purchasing, result in fewer savings than orders solicited using open market procedures; this could be due to the nature of Federal Supply Schedules. For every schedule product category, there are a finite number of contract holders offering products and services at pre-negotiated prices, which can be decreased but not increased. These two factors produce lower savings rates than those observed when examining open market purchases. However, MEDSAVE cannot consider the total savings realized when purchasing FSS products because the savings calculation fails to consider savings realized during the initial negotiation process between the schedule holder and the government. The interaction between FSS purchases and station complexity results in diminished savings for medical center complexities 1C and 2 (compared to complexity 1A) and was not a significant factor for the least complex medical centers (complexity 3). The coefficients calculated for the medical centers based on complexity alone do not follow this pattern, since the most complex medical centers (1A) realize fewer savings than the medical centers of lesser complexity. It is possible that the specialties practiced in the most complex centers result in greater physician bias expressed when purchasing supplies and instruments, and these biases are based on technical factors and not cost factors (Schneller and Smeltzer, 2006). Examining the products purchased by each facility could help determine the cause of the variation.

The MEDSAVE model also indicates that small business set-asides and micro purchases typically result in less savings than when solicitations are issued and large businesses are permitted to submit pricing. Each agency must meet small business purchasing goals, a sustainability purchasing initiative, and agencies must consider small business goals when examining strategic sourcing opportunities (Federal Acquisition Regulations, 2014; Shear et al., 2014). The decline in savings observed when small business set-asides are employed should not deter VISN-6 from considering small businesses when creating strategic sourcing business plans, but should encourage VISN-6 medical centers to determine which opportunities are most appropriate for small business set-asides. Finally, the decline in savings when

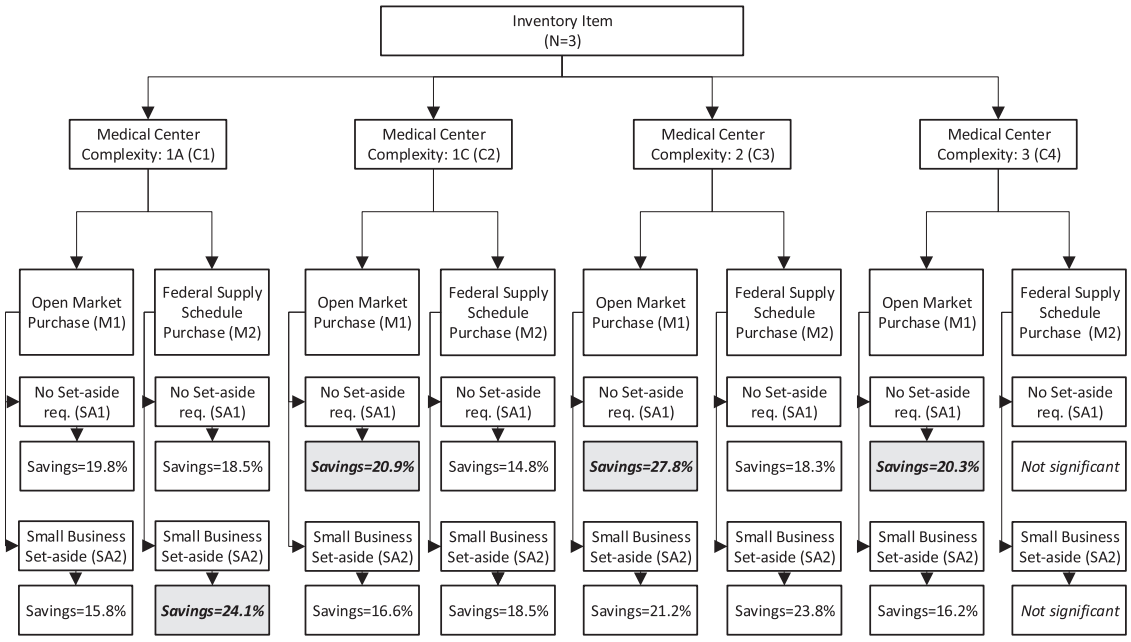

Fig. 3. MEDSAVE predicted savings, assuming three suppliers sell the item (N=3), sorted by medical center complexity. The greatest savings calculated for each medical center complexity is highlighted in bold, italicized text.

micro-purchases are made could occur because public posting of these requirements to suppliers is not required, allowing the purchasing agent to limit the potential field of suppliers by obtaining oral quotations from known sources.

An advantage of a model such as MEDSAVE is its ability to quickly target discrete purchases that support sustainability goals when hundreds or thousands of purchases are analyzed, allowing the organization to pursue strategic relationships in the identified areas. The strategic sourcing effort begins at each medical center by performing a Pareto analysis to determine the products which result in the greatest annual spend. Since the number of products included in the medical center inventories is so large, the spend categories identified by the Pareto analysis will require further analysis to prioritize the most advantageous opportunities for strategic sourcing. Each item would need to be examined to determine the potential number of suppliers, the business size of the suppliers, and whether or not the item is available on a Federal Supply Schedule or if it is an open market purchase.

In Fig. 3, we make the assumption that three suppliers (N=3) can provide a hypothetical inventory item. When examining the competitive dataset, represented by all transactions that received more than one offer, it is determined that the median number of suppliers is three, and the mean is 3.4. The decision to exclude transactions with a single offer was made due to the dataset's severe skew to the left (Fig. 2), as including these actions results in a median value of 1 and a mean of 1.8. The authors feel excluding these transactions is appropriate as a central tenant of this research is to combine competitive practices with sustainability objectives. A second assumption is that the total contract value of a contract awarded to purchase this item would exceed the micro-purchase threshold. The model is organized by hospital complexity, and the savings predicted from the MEDSAVE model appear at the end of each scenario. The factors which result in the greatest savings for the most and least complex medical centers are the same (Federal Supply Schedule purchases set-aside for small businesses), and the factors that result in the greatest savings for medical centers of complexity 1C and 2 are the same (Open Market Purchases not reserved for small businesses). The organization can now examine why complexity 1A and 3 medical centers see success with set-asides and potentially identify best practices that could be used to enhance small business participation in medical centers of complexity 1C and 2. The organization, having seen a correlation between savings and Federal Supply Small Business purchases in the complexity 1A and 3 medical centers, can also solicit a requirement, following a process similar to that documented by Andersen et al. (2016), that requests proposals from small businesses that will result in innovation, and estimating the cost of such a relationship prior to solicitation. This may not result in the realization of cost savings through purchasing, but the organization will realize efficiencies in other areas within the medical center footprint.

5. Discussion

5.1. Theoretical contribution

Spend analysis procedures and strategic sourcing methodologies have not changed significantly; what has changed is the type of supply or service being purchased (Hesping and Schiele, 2015). Industry is moving towards buyer/supplier relationships that provide more than transactional cost savings (Nollet et al., 2005), true partnerships that seek solutions outside of purchasing (Gelderman and Van Weele, 2003). Incorporating sustainable practices into corporate strategy is an accepted practice and one that can provide financial rewards (Pagell and Wu, 2009). However, strategic sourcing practices and incorporating sustainability initiatives though purchasing are studied individually. When one considers the impact of truly collaborative buyer/supplier relationships that analyze the entire supply chain, not just the purchasing department, and the desire to incorporate sustainability initiatives into organizational purchasing strategies, a need arises to develop new theories that merge and achieve multiple goals. The proposed framework expands upon previous studies by bridging the gap between strategic purchasing and sustainability initiatives realized through purchasing, and identifies how spend analyses can be used to target sourcing efforts. The framework discourages awarding contracts to suppliers who can provide the lowest cost per item, but finding true strategic partners that are uniquely positioned to enhance the buyer's organization outside of the supply chain, as observed by Saunders et al. (2015).

Purchasing departments are responsible for finding and fostering strategic relationships (Chen et al., 2004) and this research provides a method to identify areas where optimal supplier relationships can be

found within the spend portfolio. This study also allows the buyer to identify potential strategic partners early in the strategic sourcing process, allowing potential suppliers to propose innovative sustainable practices, or plans to realize additional sustainability objectives, at the start of the relationship. This aligns with literature urging collaborative partnerships to find distinctive and innovative approaches to sustainability as early as possible in the acquisition process (Pagell et al., 2010; Paulraj, 2011; Rafati and Poels, 2015). The authors believe that the model will enhance procurement efforts to meet sustainability goals, and in the case of MEDSAVE, assumes vendors who have already signaled an interest to obtain business from the VA by providing savings to the organization for discrete purchases, may also be inclined to establish a more stable buyer/supplier relationship to find efficiencies throughout the supply chain while providing needed goods.

5.2. Managerial implications

In a competitive marketplace, finding a strategic supplier that is also inclined to collaborate on innovations that will enhance the buyer's supply chain and sustainability practices, positions the buyer for great success (Jap, 1999). Strategic sourcing practices that do not require the supplier to provide additional value to the organization are long-term-price-driven relationships. While aspects of the relationship may reduce risk to the supplier, the relationship does not require either party to innovate and change, which can put both parties at a competitive disadvantage. The case study examined purchases made by medical centers for supplies that are critical for daily operations, and the results allow managers to use quantitative data to determine if trade-offs involving sustainability goals make financial sense for the organization. When the commodities are obtained as discrete purchases, the medical centers manage the entire supply chain within the hospital. A challenge in healthcare purchasing is the unpredictability of patient care; medical centers do not know which patients with which ailments will require treatment, much like a retail operation cannot predict what products will be sold (Stank et al., 1999). However, strategic suppliers can examine the buyer's organization, be it healthcare, retail, or any other business that experiences unpredictability and collaborate with the buyer to ease supply chain challenges as observed by Gottfredson et al. (2005).

Successful strategic suppliers do not always have an existing relationship with the buyer (Andersen et al., 2016). The authors believe that the spend analysis framework positions the buyer to look to suppliers that traditionally would not have been considered for a collaborative partnership. The authors believe that changing the competitive landscape from one focused on price to one focused on solutions will spur innovation in supplier communities that have been providing supplies through discrete sales, as innovative practices that extend beyond purchasing are quickly becoming a means for businesses to distinguish themselves (Vereecke and Muylle, 2006).

6. Conclusions and future research

The scope of this study was limited to identifying potential strategic purchasing opportunities that could result in collaborative relationships that enhance purchasing processes within the organization, while also allowing it to realize sustainability goals. Purchasing departments play a critical role in an organization's ability to accomplish its strategic goals, since requirements are obtained through negotiations with outside suppliers (Cooper and Ellram, 1993). Strong supplier relationships increase an organization's effectiveness and these relationships can significantly impact the efficiency of the organization (Farmer, 1981; Janda and Seshadri, 2001).

The data used in the case study was limited to that releasable under the Freedom of Information Act; while the data conformed to the sustainability goals of the organization, spend data that would have provided a clearer picture of sustainability strengths and weaknesses on the discrete purchase level was not available. The paper is limited to the spend analysis portion of the strategic sourcing process. The case study does not extend to the identification of strategic partners or the effectiveness of these partners to realize efficiencies within the medical center operation, or to meet or exceed sustainability goals set for the organization. Future research should examine the effectiveness of collaborative buyer/supplier relationships born from this process. Future research may also examine the idea of establishing strategic collaborative relationships with suppliers to promote innovation in the areas where goals were not met, in order to improve weaknesses.

Spend analysis is very dependent on the ability of an organization to obtain useful data, and a great amount of time can be spent scrubbing data sets prior to analysis. The authors also recommend researching the effect of workforce education, knowledge management initiatives, and data collection systems on the accuracy of spend data. Future studies should also consider data sources; parallels can be drawn from this model to social accounting practices, and it is likely that data collected for social accounting reports can be used to execute the spend analysis model. Social accounting examines quantitative and qualitative data to help an organization determine if sustainability goals have been met (de Beer and Friend, 2006; Lamberton, 2005). Social accounting models can also look at sustainability achievements across a particular division (Lamberton, 2000), which may not be possible when using the proposed spend analysis model, because of a lack of data. The practice of social accounting may also directly impact a spend analysis targeting sustainability and strategic purchasing goals, since the information obtained from the reporting process can influence changes in the organization's sustainable goals (Bebbington and Larrinaga, 2014).

Spend analysis, strategic purchasing through collaborative relationships, and sustainability practices can be combined to increase efficiencies in an organization while realizing environmental and social goals. While sustainability may negatively impact profitability in the short term, the efficiencies gained through the collaborative relationship can serve as a counterbalance. Strategic relationships can eliminate the number of repetitive discrete purchases made by an organization while identifying logistical processes outside of the purchasing process that result in savings.

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