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Public Procurement and Associated Relevant Elements for a Habitable Public Domain

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Abstract
Public procurement remains a critical component of government undertakings because of the avenue it provides to acquire relevant resources to address various concerns of various segments of the population in various governance arrangements. The centrality of public procurement to governance is evidenced by enormous financial resources committed by developed and developing countries annually to meet various needs and expectations of the population. As a professional field, public procurement is defined by some associated elements and various scholars have examined such elements from systems' perspective among others. One additional element which is worthy of attention and hereby the focus of this paper is professional procurement competency elements. This study uses dataset from the Universal Public Procurement Certification Council [UPPCC] survey to examine the likely determinant elements of public procurement based on multivariate analysis, specifically, exploratory factor analysis using Varimax with Kaiser normalization, and multiple linear regression. The analysis attests to multidimensionality of public procurement with strategic procurement planning; contract administration; procurement administration; supply management; sourcing; and negotiation process as key determinant elements. These key determinant elements converge into three clusters and further convey very critical, important, and necessary expectations for public procurement regardless of the locale. The study highlights the multifaceted and interwoven nature of public procurement and draws implications for theory, praxis and policy.
Keywords: public procurement**,** purchasing, acquisition, professional procurement, procurement competency elements, contract management.

1. Introduction

Government responsibility to citizens, particularly, in providing needed goods and services is pertinent to achieving the public purpose. Providing goods and services are necessary for sustaining and protecting life and property. Since time immemorial, the bureaucracy, which is considered to be a critical arm of government remains the viable machinery for providing such needed goods and services to various segments of the population either directly or indirectly. And public procurement which entails various means and processes of acquiring goods and services including administration, execution and evaluation has become such a critical functional element in the day-to-day management of peoples' affairs (Thai, 2001; Qiao, Thai & Cummings, 2009; Pontré, Welter, Malta, Faria & Chernyshova, 2011; Ribeiro et al., 2018).

Public Procurement according to the U.S. Congress in 2003 in 41 U.S.C. 403(2) "includes all stages of the process of acquiring property or services, beginning with the process for determining a need for property or services and ending with contract completion and closeout." This conceptual explication highlights public procurement as an all-encompassing activity with multiple parts consisting of decision making, engagement of relevant parties, acquiring goods and services and evaluating consequences as preludes to current and future choices on how best to achieve the public purpose. Thus, public procurement is not just a punctuation on an equilibrium in acquiring goods and services, but rather entails stages and processes of obtaining relevant resources with attendant efforts for the common good. In fact, procurement of goods and services constitutes one of the essential functions of municipal, county, state and federal governments (Qiao et al., 2009; Gordon, Zemansky, & Sekwat, 2000; Thai, 2001).

As a key part of public administration functions, public procurement is gradually emerging as a viable academic area of study. Scholars such as Thai (2001), Lazenby (2010), Cooper (1980), Flynn & Davis (2014), Clark (2003), Prier, McCue, and Behara (2010), MacManus and Watson (1990), Snider & Rendon (2012) among others have persuasively documented the importance of public procurement to public administration and governance in general. Thai (2001) relates how public procurement is a key part of public sector economics within the context of roles and responsibilities of government to citizens. For instance, on the average, developed countries spent approximately 20% of their gross domestic product (GDP) on public procurement while it is about 50% for some developing countries (Callendar & Mathews, 2000; Carter & Grimm, 2001; Schiavo-Campo & Sundaram, 2000; Snider & Rendon, 2012; Ribeiro, Inacio, Rauen & Li, 2018).

The general acknowledgement of the importance of public procurement to public administration is somewhat complicated by the lack of commonly accepted definition of the concept. The lack of consensus among scholars and practitioners on the concept creates an opportunity to legitimately question whether there is

clarity on key elements and even uniformity as it relates to functions of public procurement. Prier and McCue (2009) highlight how problematic lack of commonly accepted definition of public procurement impacts its practice and somewhat theory building. However, the lack of a commonly accepted definition for the concept of public procurement does not necessarily confound identifying some commonalities in task elements. This paper therefore focuses on public procurement and explores possible key determinant elements as a conduit to help establish some parameters for conceptual understanding with the attendant practical application and implications. To some extent, scholars have over the years focused on conceptual explication of public procurement, but with limited methodological exploration of the term and its associated elements. The lack of methodological exploration of the concept creates some gap in the literature and somewhat in praxis. This study hereby intends to help close such a gap and uses data garnered from the Universal Public Procurement Certification Council [UPPCC] survey in 2012, which was based on various public procurement professional elements. This study uses data reduction technique, factor analysis and multiple linear regression for analysis and interpretation of findings. The authors anticipate by exploring public procurement and attendant elements will augment knowledge and application for the greater good.

2. Conceptual Framework of Public Procurement

Public procurement is an essential component for governance because of the impetus of meeting needs and expectations of citizens. Whether in advanced democracies or nascent ones, public procurement enables provision of goods and services in fulfillment of social contract obligations of government. In fact, various governments in different parts of the world spend quite a sizable portion of their gross domestic product (GDP) on public procurement for various sectors and categories of services (Snider & Rene, 2012). In the U.S., public procurement responsibilities are visible at the city/municipal, county, state and federal levels, with the federal government's procurement for essential public goods such as national defense and education among others as critical to achieving the public purpose (Thai, 2001; Klay, 2015).

As a concept, public procurement has been subjected to various explications by scholars and practitioners alike which somewhat creates some complexities in understanding. Prier and McCue (2009) acknowledge the variations in conceptual explication of public procurement by alluding to ambiguities and its impact on praxis and policy. For instance, various scholars use terms such as purchasing, acquisition, public procurement, contracting, material management, procurement, and supply chain management among others interchangeably to connote acquiring goods and services, and managing associated efforts to achieve the public purpose and/or policy outcomes (Prier & McCue, 2009, p. 330). The variation in terms appears to suggest public procurement means different things to various segments of the population, but a careful observation reveals it is mostly a case of lack of generally accepted definition. In fact, a careful review of various explications of the term public procurement mostly describes similar line of tasks even though there are some variations in task details.

The concept public procurement has the word 'public' as a key component. Public in this context is about people within the framework of governance as government's principal responsibility remains management of peoples' affairs on a day-to-day basis. Public thus relates to achieving the public purpose or otherwise stated publicness which distinguishes government activity from private/industry endeavors (Denhardt, 2009; Dong, 2015). Thus, public makes procurement a public purpose activity and the term public procurement as used in this paper refers to harnessing resources for government-centered activity and related efforts geared toward meeting needs and expectations of citizens and/or the governed for the common good (Klay, 2015; Bryson & Crosby, 1992)

In his seminal publication on public procurement, Thai (2001, pp. 42-43) relates procurement "encompasses acquisition, contracting, buying, renting, leasing, and purchasing, to include functions such as requirements determination and all phases of contract administration." Thai's definition points to the multifaceted and holistic nature of public procurement as it relates to all stages of public service delivery value stream. Thus, regardless of the form of public procurement, process, products/goods, people, purpose and administration of resources are key components. Other scholars such as McCue and Gianakis (2001), Byrne (1999), Kraljic (1983), Romzek & Johnston (2005), Erridge (2000), Prier & McCue (2009), Dimitri (2013), Snider & Rendon (2012), Nash, Schooner, Warren & Welch (2004), Waelchli (1985), Lloyd (1999), Cavinato & Kauffman (2000), Qiao et al., (2009), Greve (2008), Snider (2006), Lee & Dobler (1977), Gordon, Zemansky, & Sekwat (2000), Matthews (2005), Rendon (2005), Rendon & Snider (2008) among others equally elucidate the concept public procurement in ways that are similar to Thai (2001) conceptualization of the term. Furthermore, there are other related explanations of the concept public procurement.

In the perspective of the American Bar Association (2000, p. 7), public procurement entails "buying, purchasing, renting, leasing or otherwise acquiring any supplies, services or construction" including "all functions that pertain to the obtaining of any supply, service or construction, including description of requirements, selection, and solicitation of sources, preparation and award of contract, and all phases of contract administration." This conceptualization further points to process, methodical and holistic nature of public

procurement as against punctuated participation in service delivery within the governance context. Admittedly, Erridge (2000, p. 14-15) views public procurement as "the whole process of acquisition from third parties, and covers goods, services and turnkey projects. It spans the complete 'cradle to grave' life cycle, includes both traditional funding and more innovative arrangements e.g. PFI, and is inherently multifunctional," which further points to the multifaceted nature of public procurement. The similarities and differences in conceptual explication of public procurement is equally evidenced in state and local government statutes.

Some states and counties in the U.S. define public procurement in their statutes. For instance, section 20(B) of the state of Arkansas Office of State Procurement (2003, p. 7) defines public procurement as the "description of requirements, selection and solicitation of sources, preparation and award of contract, disposal of commodities, and all phases of contract administration." New York State in its Procurement Guidelines (2014, p. 50) referenced public procurement as "the acquisition of goods and/or services." Maricopa County of Arizona in their Procurement Code (Article 1, Section 1-101-83) defines procurement as "buying, purchasing, renting, leasing or otherwise acquiring any information, materials, services or construction" and Broward County of South Florida's definition of public procurement is similar to that of Maricopa County (chapter 21: 1988-0180). For the most part, these definitions have more similarities than differences and speak to the many tasks that constitute public procurement at the various levels of government. Thus, whether at the local, national and/or international context, public procurement is such an essential function of government in order to achieve the government rationale for citizens' wellbeing regardless of whether the procurement function is directly performed by a government entity or if a private entity is contracted to perform the function on behalf of government.

Prier and McCue (2009, p.361) on their part conceptualize public procurement as the "designated legal authority to advise, plan, obtain, deliver, and evaluate a government's expenditures on goods and services that are used to fulfill stated objectives, obligations, and activities in pursuant of desired policy outcomes." This definition equally underscores a wide ranging nature of public procurement and its policy instrument role with legal implications for achieving the public purpose. It is apparent public procurement is not just about goods and services, but entails attendant key elements and processes to deliver outcomes that address concerns of the governed in a particular locale. This paper relies on Prier and McCue's (2009) conceptualization of public procurement as foundational to analysis and attendant discussions. The authors are of the view that the variation in definition of the concept public procurement does not necessarily prevent drawing relevant relatedness in terms of functionality.

It is worth emphasizing that public procurement is multifaceted, but related to contracting, supply chain management, and acquisition among others. For instance, contracting even though limited in scope when compared to public procurement, does have related elements such as specifying expectations, requesting bids, selecting preferred providers, and contracting awards and administration (Greve, 2008; Hajek et al., 2017; Nash, Schooner, O'Brien-DeBakey, & Edwards, 2007; Kazaz et al., 2017). Supply chain management entails conscious efforts to derive better outcomes through ensuring effective and reciprocal relationship between supplier and buyers (Prier and McCue, 2009, Cavinato, Flynn, & Kauffman, 2006; Burt, Petcavage, & Pinkerton, 2010). And pending the context of use, acquisition for the most part is considered akin to public procurement and there appears to be a reasonable consensus among some scholars and practitioners on the relatedness of the two terms based on a careful examination of functional elements and processes even though some scholars are still of the view that public procurement is broader and acquisition is one of the key aspects (American Bar Association, 1979; Byrne, 1999; Warren &Welch, 2004; Services Acquisition Reform Act, 2003; Snider & Rendon,2012; Byrne, 1999; Erridge, 2000). Regardless of the various positions, it is legitimate to assert that public procurement, contracting, acquisition and supply chain management among others are somewhat related and point to efforts to acquire needed resources to enable provision of goods and services, and manage attendant expectations in order to fulfill the public purpose. Furthermore, the importance of public procurement as key government activity cannot be overstated.

Public procurement offers tremendous benefits as it relates to achieving the public purpose. Scholars such as Thai (2001), McCue & Gianakis (2001), Gordon, Zemansky, & Sekwat (2000), Snider & Rendon (2012), Rendon & Snider (2008), Fernandez (2007), Snider (2006) and others assert the difference public procurement makes in administration of peoples' affairs. For instance Thai (2001), Fernandez (2007), Gordon, Zemansky, & Sekwat (2000), Qiao et al.,(2009) underscore criticalness of public procurement to public management, particularly, as a responsive administrative mechanism for service delivery on day-to-day basis to various segments of the population. Perspectives on public procurement by Bartha & Snider (2010), Rendon & Snider (2008), Snider & Rendon (2012), McCue & Gianakis (2001) highlight how procurement help achieve policy intents and purposes i.e. in the area of national defense by enabling acquisition of essential weaponry to carry out domestic and international security duties. Scholars such as White (2009), Michaels (2010), Akenroye (2014), Knight, Caldwell, Harland, & Telgren (2003), Bolton (2006), Arrowsmith (1995) also point out how public procurement serves as a tool to achieve social outcomes in terms of promoting representation and participation

of minority businesses in government's economic activity. Furthermore, viewpoints of McCue & Gianakis (2001), Gordon, Zemansky, & Sekwat, (2000), Thai (2001), Romzek & Johnston (2005), Brown & Potoski (2003) equally emphasize how public procurement enables harnessing human capital and promotes professional development across various levels of government for effective performance. And scholars such as Schiavo-Campo & Sundaram (2000), Callendar & Mathews (2000), Grandia, & Meehan (2017), and Carter & Grimm (2001) on their part, accentuate how public procurement plays a key part in growth and development of the national agenda of many nations in both developed and developing economies among others.

The benefits of public procurement as it relates to achieving the public purpose as highlighted above makes it such a keystone to building and sustaining societal growth through government mechanisms. However, there are challenges of variations in definition and attendant complications for practical purposes at various levels. For instance, the lack of a universally accepted definition of public procurement clouds standardization of tasks, developing relevant competencies including theoretical development (Prier & McCue, 2009; Snider and Rendon, 2008); and the profession is susceptible to corruption if proper audit and regulatory measures are not in place (Nagle, 1999; Walker, 2005; Hutton, 2008; Woods, 2006; Charron, Dahlström, Fazekas, & Lapuente, 2017). Despite the associated challenges, public procurement at various levels of government has admittedly become such a strategic endeavor in promoting responsive government (Murray, 2007; Klay, 2015; Glas et al., 2017; McCue & Gianakis, 2001; Matthews, 2005; Rendon, 2005; Prier and McCue, 2009; Lazenby, 2010) and there appears to be some consensus on some of the basic expectations for public procurement professionals at various jurisdictions. This paper will highlight some key determinant element(s) that guides public procurement as a conduit to providing some clarity on key variables that drive the profession and by doing so augment knowledge, understanding and general praxis of public procurement.

3. Public Procurement and Attendant Elements

The role of public procurement in achieving the public purpose as it specifically relates to meeting needs and expectations of citizens as part of the government rationale cannot be overstated. Whether in the area of national defense, education, social programs, health, and environment initiatives among others, public procurement is critical to achieving the public purpose. The amount of resources that is expended annually on public procurement as evidenced by GDP per capital expenditure in developed and developing countries (Callendar & Mathews, 2000; Carter & Grimm, 2001; Snider & Rendon, 2012; Ribeiro et al., 2018) attests to its important role in the management of peoples' affairs.

As a key government function, public procurement does have some essential elements and scholars such as Thai (2001), Prier and McCue (2009) provide some insight into some of those elements. Prier and McCue in their 2009 publication (p.328-338) identify legal authority, organizational matrix, and procurement activities as three key elements of public procurement. The legal authority element explicates the interchangeable use of public procurement and acquisition; prioritization of agency needs, and resources, and how acquisition appears to be a more acceptable legal term nowadays when it comes to securing resources for various projects and programs (p.338-345). The organizational matrix element highlights proper use of public procurement to achieve organizational goals by establishing clear structure and attendant functional roles as a conduit to promoting efficiency and accountability (p. 345-349); and the procurement activities element emphasizes relevant and acceptable competencies that are necessary for effective performance in public procurement and the need for a universally accepted definition to streamline efforts (p, 351-357). For instance, Prier and McCue (2009,p. 360), identify "technical and supplier research; contacting suppliers; quality references and background review; negotiation over numerous criteria such as price, specifications, delivery schedules, etc., fulfillment of order which includes supplier preparation, shipment, receiving, and payment; and evaluation" as key procurement undertakings. These three elements are within the systems' perspective of public procurement and are geared toward ensuring effective processes and beneficial consequential outcomes for organizational and societal benefits (Warren & Welch, 2004). Relatedly, Thai (2001) uses the systems' perspective as well to deconstruct public procurement.

Thai (2001) examines public procurement within the systems framework using institutional approach and procurement system in action to underscore the dynamic and strategic nature of public procurement. Within the institutional approach, five elements vis-a-vis "policy making and management; procurement regulations; procurement authorization and appropriations; public procurement function in operations; and feedback" (p. 17) are depicted. And within the procurement system in action, various environments that impact public procurement such as political, legal, socio-economic, internal, market among others are discussed with a highlight of the duality of environmental impacts i.e. between public procurement and attendant environments (p.33). For instance, as it pertains to the institutional approach elements, the policy making and management point to intricacies in legislating on public procurement; procurement regulations alludes to the enormousness of public procurement in relation to government economic activity and the need for regulatory oversight; procurement authorization and appropriations focus on the connectedness of fund allocations and legitimation as a key part of

the procurement system and attendant outputs/outcomes; public procurement function in operations addresses resource production issues i.e. personnel, organizational structural arrangements, processes and procedures; and feedback points to evaluation of various procurement activities and operations, modifications, replications and continuous improvement efforts to ensure better outcomes for public procurement (p.17-32).

Utilizing the systems framework, Thai (2001), Prier and McCue (2009) among other scholars thereby point out essential key elements of public procurement in achieving the public purpose, particularly, the related and interconnected nature of various elements associated with public procurement. One other set of elements which is related, but different from the ones enumerated above is knowledge elements which are competencies associated with professional procurement practice. This research which focuses on public procurement intends to explore these elements in order to establish some nexus between public procurement and associated professional knowledge elements for effective performance. One of the expectations is that some clarity on key determinant element(s) associated with public procurement, especially, as it relates to professional practice, will help promote uniformity and strategic engagements for societal benefits. Perhaps, doing so could also allow for better theoretical development which could further augment academic and professional development of the field. This research will utilize dataset from Universal Public Procurement Certification Council [UPPCC] survey which was conducted in 2012 and has six elements such as procurement administration; sourcing; negotiation process; contract administration; supply management; and strategic procurement (UPPCC, 2012). There are various statements measuring each element. The study will be guided by the hypothesis that one key dominant determinant element underlies public procurement. The study will explore such a hypothesis using factor analysis and multiple linear regression for interpretation and discussion of findings. In the end, the study will draw some relevant implications for theory, policy, and practice of public procurement.

4. Materials and Methods

This study uses survey data collected in 2012 by the Universal Public Procurement Certification Council (UPPCC), a body that administers tests and certifies public procurement professionals. The survey focuses on various tasks performed by public procurement professionals and the attendant knowledge associated in performing those tasks. The instrument is duly termed job analysis survey to better relate what the survey intends to accomplish (the information in this section of the paper is synthesized from the 2012 UPPCC study report).

The survey has six segments: background and general information; tasks; knowledge; recommendations; comments and industry information (UPPCC, 2012). The survey is administered to 37,000 procurement professionals in North America and other regions of the world from May-June, 2012, and is completed by 2,593 of the participants out of which 2,019 valid responses are used in this study. Most of the participants are certified within the past 10 years, are educated and reside in U.S. and Canada. Approximately 60% of the respondents are female and 40% male and they fall within under 25 to over 66 year brackets with education level ranging from high school to doctoral and the organization size ranges from less than 100 employees to over 10,000 employees, and years of employment in procurement ranges from less than 1 year to over 25 years covering various professional positions in city, municipal, county, state governments, and education sector among others.

Both the tasks and knowledge aspects of the instrument are rated on a five point Likert Scale, from 0- 4 (0= of no importance to; and 4= very important) and covers elements such as procurement administration, sourcing, negotiation process, contract administration, supply management, and strategic procurement planning (UPPCC, 2012). The authors employ factor analysis using Varimax with Kaiser normalization to explore these elements as part of the attempt to make a case for possible key determinant element(s) for public procurement. The factor analysis is complemented by multiple linear regression which highlights the relationship between predictor and criterion variables as it pertains to the identified element(s), and together help make a sound and cogent argument for public procurement.

5. Analysis

This segment of the study consists of results based on factor analysis and multiple linear regression. The segment starts with factor analysis consisting of four tables, one figure and attendant interpretation, and ends with a discussion of multiple linear regression results which also has four tables and one figure. The factor and regression analysis are complementary and help to ascertain key determinant element(s) of public procurement by examining the relationship between the variables.

5.1 Factor results

The rationale for this segment of the study is to ascertain dimensionality of public procurement based on responses to UPPCC 2012 survey. The analysis involves four tables and one figure (Tables 1-4, and figure 1). Table 1 has the KMO and Barlett's test as measures of sampling adequacy; Table 2 contains the rotated component matrix; Table 3 displays the eigenvalues of the variables and total variance explained; and Table 4 shows the commonality estimates of the rotated component matrix; and Figure 1 has the scree plot of the factors.

Tables for anti-correlation matrix and correlation matrix are not included because of space limitation, but the associated brief narratives are provided for needed insight. Collectively, the results help to ascertain key determinant element(s) associated with public procurement.

The study utilizes factor analysis which is a data reduction technique to help classify variables that are related to enable better identification and interpretation. The authors carefully examine the dataset to ensure it meets the assumptions of factor analysis before proceeding with the analysis. Thus, relevant assumptions such as interrelatedness of the variables, sample homogeneity, greater than .30 correlation, assumption of multivariate normality among others are met (Berman and Wang, 2012; Yong & Pearce, 2013; Hair et al., 2006; 2009; Agbodzakey & McCue, 2015; Green and Salkind, 2011). Furthermore, the authors ensure the appropriate population sample size for factor analysis with at least 50 participants is equally met (Tabachnick and Fidel, 2012; Hair et al., 2009). This study has 2019 effective participants which is more than excellent for factor analysis.

In an attempt to identify relationship between the variables, classify and appropriately name the elements, the authors initially explore various factor solutions (4-8) with the variance explained ranging from 63%-72%. The authors eventually opt for a six factor solution because of its appropriateness for delineation and interpretation. There are no cross loading of the variables with the six factor solution. Also, values less than .50 are suppressed. The six factor solution explain 72% of the variance and converge into three clusters (see Tables 1-4 for details).

5.2 KMO and Barlett's test

The Kaiser-Meyer-Olkin (KMO) measures sampling adequacy with greater than 0.5 signifies appropriateness to proceed using factor analysis. The preliminary KMO for all factors is .969 and it remains the same even when four, five and six factor solutions are respectfully identified. The authors eventually relies on the identified six factor solution for analysis and interpretation of findings. In this case, KMO of .969 is meritorious and signifies acceptability to proceed with factor analysis (see Table 1)

Table 1. Measures sample adequacy

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.969
Bartlett's Test of Sphericity	Approx. Chi-Square	59442.777
	Df	780
	Sig.	.000

The rotated component matrix shows the loading of 40 statements measuring elements of public procurement (see Table 2). The rotated component matrix produced six (6) factor solutions. Statements measuring strategic procurement planning loaded on factor 1; statements measuring contract administration loaded on factor 2; statements measuring procurement administration loaded on factor 3; statements measuring supply management loaded on factor 4; statements measuring sourcing loaded on factor 5; and statements measuring negotiation process loaded on factor 6. Even though the authors opted for six factor solution because of the appropriateness of the loadings for interpretation purposes, attempts were made to force a four (4) and five (5) factor solutions as well to ascertain the likely relationships between the various elements which somewhat yielded interpretable loadings. Admittedly, the six factor solution better relate the relationships between key determinant elements of public procurement.

The factor loading per element also helps to better understand the rudiments associated with each element of public procurement. For element 1, 'forecasting techniques and strategies' has the most value (.805) while 'succession planning' has the least value (.698); for element 2, 'contract renewal process' has the most value (.813) while 'techniques to ensure supplier compliance to specifications' has the least value (.541); for element 3, 'procurement audit and review processes' has the most value' (.715) while 'common procurement performance measurement criteria' has the list value (.535); for element 4, 'asset management' has the most value (.806) while 'ordering process' has the least value (.713); for element 5, 'total cost of ownership concepts' has the most value (.657) while 'scope of work for service contracts' has the least value (.508); and last but not the least, for element 6, 'negotiation process and documentation requirements' has the most value (.773) while 'problem solving and decision making techniques and processes' has the least value (.714). Overall, out of the factor loading for the six elements, 'contract renewal process' which is part of element 2 with a value of .813 represents the variable with the most value while 'scope of work for service contracts,' which is part of element 5 with a value of .508 represents the variable with the least value (see Table 2). Together, the factor loading of variables with most and least values based on rotated component matrix help relate the elements of public procurement.

Table 2. Factor loadings of the statements measuring elements of public procurement

Rotated Component Matrix[a]	
Component/element 1	
Forecasting techniques and strategies: SPforecasttechsimp	.805
Procurement strategies based on forecast data, market factors, and economic trends: SPprocurestratimp	.803
Strategic planning: SPstratplanningimp	.798
Cost/benefit analyses on future acquisitions: SPcostbenanalysacquimp	.782
Analytical techniques (e.g., Pareto analysis): SPanalytechniquesimp	.756
Research techniques: SPresearchtechniquesimp	.733
Contingency/continuity of operations planning (e.g., disaster preparedness): SPcontingopsplanningimp	.727
Succession planning: SPsuccessionplanningimp	.698
Component/element 2	
Contract renewal process: CAcontrenewprocimp	.813
Contract modifications (e.g., change orders, amendments, escalation): CAcontmodsimp	.810
Contract renewal process: CAelementcontimp	.778
Contract termination (e.g., default, convenience, nonappropriation): CAconttermimp	.804
Contract performance deficiencies, disputes, and resolutions: CAcontperfdefdisresimp	.752
Contract management (e.g., performance, ongoing risk): CAcontmgmtimp	.728
Techniques to evaluate supplier performance: CAtechevalsupperfimp	.579
Techniques to ensure supplier compliance to specifications: CAtechnsursuppcompimp	.541
Component/element 3	
Procurement audit and review processes: PAprocauditrevprocimp	.715
Purpose for department audits and reviews: PApurpdeptaudrevimp	.703
EProcurement programs: PAeprocureprogsimp	.678
Automated procurement systems (e.g., electronic requisitioning): PAautoprocsysimp	.673
Cooperative procurement programs: PAcoopprocprogsimp	.630
Value analysis (e.g., cost-reduction, cost avoidance, etc.): PAvaluanalysisimp	. 623
Solicitation and contract file contents: PAsoliccontrafilesimp	.564
Common procurement performance measurement criteria: PAcommprocperfmeasimp	.535
Component/element 4	
Asset management: SMassetmgmtimp	.806
Disposition of obsolete and surplus equipment and materials: SMdisposobssurplusimp	.786
Inventory management techniques and principles: SMinvenmgmttechimp	.782
Supply chain management: SMsuppchainmgmtimp	.765
Ordering process (e.g., route, expedite, follow-up): SMorderingprocimp	.713
Component/element 5	
Total cost of ownership concepts: SCtotcostownerconcimp	.657
Supply and demand concepts: SCsuppdemandconcimp	.657
Market research resources: SCmktreserchresimp	.624
Product specifications, descriptions, and prices (e.g., order history): SCprodspecdespricimp	.618
Make, lease, or buy concepts: SCmakeleasebuyimp	.606
Procurement methods and techniques: SCprocmethtechimp	.576
Benchmarking techniques and processes: SCbenchmrktechprocimp	.571
Scope of work for service contracts: SCscopeofworksvcconimp	.508
Component/element 6	
Negotiation process and documentation requirements: NPnegoprocdocrequimp	.773
Negotiation strategies and techniques (e.g., conflict resolution): NPnegostrattechimp	.762
Problem solving and decision making techniques and processes: NPprobsolvdecmakimp	.714

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 7 iterations.

Table 3 lists the eigenvalues for factors from 1 through 6 out of the 40 statements measuring the elements and shows the extracted factors using Varimax with Kaiser normalization. Eigenvalues are variances of factors with values > 1 recommended by scholars to be retained in a study (Green and Salkind, 2011; Norusis, 2005) among others. There are 6 extracted factors which account for the variable variance with attendant eigenvalues and are displayed in Table 3. The six extracted factors account for 72% of the response variance to elements of

public procurement. Factor 1, which is strategic procurement planning element accounts for 18% of the variance; factor 2, which is contract administration element accounts for 16% of the variance; factor 3, which is procurement administration element accounts for 11% of the variance; factor 4, which is supply management element accounts for 11% of the variance; factor 5, which is sourcing element accounts for 10% of the variance; and factor 6, which is negotiation process element accounts for 6% of the variance. Overall, the six extracted factors converge into three clusters: cluster 1 which consists of two elements explains 34% of the variance; cluster 2 which consists of three elements explains 32% of the variance and cluster 3 which consists of one element explains 6% of the variance. Together, the variables explain 72% of the variance.

Table 3. Eigenvalues of the variables and the variance explained by the various factors

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	19.090	47.726	47.726	19.090	47.726	47.726	7.252	18.129	18.129
2	3.162	7.904	55.631	3.162	7.904	55.631	6.224	15.560	33.689
3	2.231	5.578	61.209	2.231	5.578	61.209	4.475	11.188	44.877
4	1.680	4.199	65.408	1.680	4.199	65.408	4.415	11.038	55.915
5	1.371	3.428	68.836	1.371	3.428	68.836	4.032	10.079	65.994
6	1.109	2.774	71.610	1.109	2.774	71.610	2.247	5.616	71.610

Extraction Method: Principal Component Analysis

5.3 Anti-correlation matrix

The anti-correlation matrix shows variable values are >.5 but the values on the diagonal have small values. The matrix depicts the variables are free of unexplained correlation and the variables values >.5 indicates good measure of sampling adequacy. Furthermore, the significance of the Barlett's test of sphericity with associated probability of <.05 significance level affirms relationship among the variables and acceptability to conduct factor analysis.

5.4 Correlation matrix

The correlation matrix which highlights correlation of the variables suggests some of the variables have correlation < .30 even though correlation of variables > 30 is usually required for factor analysis (Hair, 2009). The authors in this case are able to proceed with factor analysis because the KMO and Barlett's test of sphericity affirms it is suitable. Furthermore, the anti-correlation matrix suggests the variables are free of unexplained correlation. The factor loadings are high among variables of similar dimension which further imply correlation of the variables and appropriateness to proceed with factor analysis.

5.5 Commonalities

The extraction of commonalities estimates using principal component analysis points to most of the values that are >.5 which connotes the variables fit well into the factor solution with exception of 'common procurement performance measurement criteria' at .45 and is thereby removed from the rotated component matrix. Table 4 displays the commonalities estimates for the various variables.

Table 4. Commonality estimates of the rotated components matrix

	Initial	Extraction
Automated procurement systems: PAautoprocsysimp.	1.000	.531
Solicitation and contract file contents: PAsoliccontrafilesimp	1.000	.547
Cooperative procurement programs: PAcoopprocprogsimp	1.000	.551
Value analysis: PAvaluanalysisimp	1.000	.677
Procurement audit and review processes: PAprocauditrevprocimp	1.000	.646
Purpose for department audits and reviews: PApurpdeptaudrevimp	1.000	.627
EProcurement programs: PAeprocureprogsimp	1.000	.546
Product specifications, descriptions, and prices: SCprodspecdespricimp	1.000	.584
Scope of work for service contracts: SCscopeofworksvcconimp	1.000	.560
Benchmarking techniques and processes: SCbenchmrktechprocimp	1.000	.676
Procurement methods and techniques: SCprocmethtechimp	1.000	.611
Supply and demand concepts: SCsuppdemandconcimp	1.000	.744
Total cost of ownership concepts: SCtotcostownerconcimp	1.000	.772
Make, lease, or buy concepts: SCmakeleasebuyimp	1.000	.720
Market research resources: SCmktreserchresimp	1.000	.727
Negotiation strategies and techniques: NPnegostrattechimp	1.000	.884
Problem solving and decision making techniques and processes: NPprobsolvdecmakimp	1.000	.805
Negotiation process and documentation requirements: NPnegoprocdocrequimp	1.000	.880
Techniques to evaluate supplier performance: CAtechnsursuppcompimp	1.000	.610
Techniques to evaluate supplier performance: CAtechevalsupperfimp	1.000	.682
Contract renewal process: CAelementcontimp	1.000	.746
Contract management: CAcontmgmtimp	1.000	.753
Contract performance deficiencies, disputes, and resolutions: CAcontperfdefdisresimp	1.000	.791
Contract modifications: CAcontmodsimp	1.000	.784
Contract termination: CAconttermimp	1.000	.797
Contract renewal process: CAcontrenewprocimp	1.000	.780
Ordering process: SMorderingprocimp	1.000	.666
Inventory management techniques and principles: SMinvenmgmttechimp	1.000	.791
Disposition of obsolete and surplus equipment and materials: SMdisposobssurplusimp	1.000	.785
Asset management: SMassetmgmtimp	1.000	.844
Supply chain management: SMsuppchainmgmtimp	1.000	.818
Analytical techniques: SPanalytechniquesimp	1.000	.727
Research techniques: SPresearchtechniquesimp	1.000	.738
Forecasting techniques and strategies: SPforecasttechsimp	1.000	.845
Procurement strategies based on forecast data, market factors etc. SPprocurestratimp	1.000	.840
Strategic planning: SPstratplanningimp	1.000	.825
Cost/benefit analyses on future acquisitions: SPcostbenanalysacquimp	1.000	.829
Contingency/continuity of operations planning: SPcontingopsplanningimp	1.000	.743
Succession planning: SPsuccessionplanningimp	1.000	.704

Extraction Method: Principal Component Analysis

The scree plot below (see figure 1) which is a graph of eigenvalues against all of the factors helps to determine how many factors to retain. As it relates to this study, the scree plot attests it is acceptable to retain six factors.

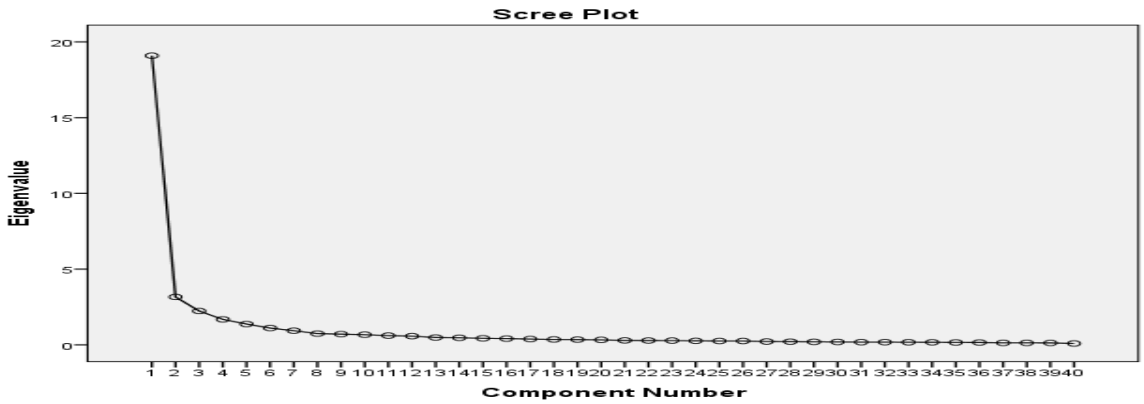

Figure 1: Scree plot of the factors

5.6 Validation

To enable generalizability of the findings, a different orthogonal rotation procedure, Equamax is deployed. The factor loadings in the rotated and unrotated correlation matrixes are the same which imply the factor structures are stable and suitable for analysis. Also, reliability analysis on statements measuring the various elements of public procurement yield a coefficient alpha of .87 for procurement administration .91 for sourcing .91 for negotiation .94 for contract administration .92 for supply management and .96 for strategic procurement. The reliability analysis indicates satisfactory reliability.

5.7 Multiple linear regression

The multiple linear regression analysis based on variables from elements of public procurement is presented in Tables 5-8. Table 5 displays the descriptive statistics of the variables; Table 6 shows the R square and Adjusted R square of the regression model, Table 7 highlights association of the criterion and predictor variables as the model summary, and Table 8 depicts the contribution per predictor variable to the regression equation. The regression analysis alongside factor analysis help to underscore multiple factors are responsible for public procurement.

The descriptive statistics in Table 5 displays the means of the six variables used in the regression analysis. Five (5) of the variables: product specifications, descriptions, and prices; common procurement performance measurement criteria; negotiation strategies and techniques; techniques to ensure supplier compliance to specifications; and ordering process record at least, a mean of 3.0 with exception of analytical techniques that records a mean of 2.6 (see Table 5)

Table 5. Displays descriptive statistics of the variables in the regression model

Descriptive Statistics

	Mean	Std. Deviation	N
product specifications descriptions and prices	3.03	1.055	2019
Negotiation strategies and techniques	3.31	.950	2019
Common procurement performance measurement	3.09	1.019	2019
Techniques to ensure supplier compliance to specifications	3.203	.9654	2019
Ordering process	3.00	1.104	2019
Analytical techniques	2.68	1.193	2019

Table 6 shows analysis of elements as key determinants for public procurement. The coefficient of the various determinants, R square provides insight into the proportion of variation explained by the predictor variables as contained in the model. The table shows when the five best selected variables are paired with product specifications, descriptions, and prices which is a key part of sourcing and is the dependent variable in this analysis, the values of R square and adjusted R are about the same (.424 and .422) which points to the combined predictive power of the predictor variables of public procurement. Thus, there is no fall in the coefficient of determination even though predictor variables are added. The correlation between the criterion and predictor variables is .65. Overall, 42% of the variation in determinant elements of public procurement is explained by the predictor variables.

Table 6. Shows the R square and adjusted square of the regression model

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.651[a]	.424	.422	.802	.424	296.155	5	2013	.000

a. Predictors: (Constant), Analytical techniques, Common procurement performance measurement, Ordering process, Negotiation strategies and techniques, Techniques to ensure supplier compliance to specifications

b. Dependent Variable: Product specifications, descriptions, and prices

Table 7 below depicts positive association between the criterion variable 'product specifications, descriptions, and prices' which is a key part of sourcing and predictor variables 'analytical techniques', 'common procurement performance measurement', 'ordering process', 'negotiation strategies and techniques', and 'techniques to ensure supplier compliance to specifications.' There is a significance relationship as depicted by .000 significance level.

Table 7. Depicts association of the criterion variable and predictor variables

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	952.199	5	190.440	296.155	.000[b]
	Residual	1294.442	2013	.643		
	Total	2246.642	2018			

a. Dependent Variable: Product specifications, descriptions, and prices

b. Predictors: (Constant), Analytical techniques, Common procurement performance measurement, Ordering process, Negotiation strategies and techniques, Techniques to ensure supplier compliance to specifications

Table 8. Displays coefficient of the variables

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	.320	.079		4.075	.000	.166	.474					
	Negotiation strategies and techniques	.127	.023	.114	5.445	.000	.081	.173	.439	.120	.092	.649	1.542
	Common procurement performance measurement	.176	.020	.170	8.834	.000	.137	.215	.434	.193	.149	.770	1.299
	Techniques to ensure supplier compliance to specifications	.193	.024	.176	7.975	.000	.145	.240	.508	.175	.135	.585	1.710
	Ordering process	.240	.019	.251	12.600	.000	.203	.277	.503	.270	.213	.720	1.389
	Analytical techniques	.154	.019	.174	8.185	.000	.117	.191	.481	.179	.138	.635	1.574

a. Dependent Variable: Product specifications, descriptions, and prices

The total sum of squares (190.440+1294.442) reflects the error that occurred associated with the attempt to predict the relationship between predictor variables and the criterion variable. The F ratio was 296.155 and the statistical significance level was .000 which points to the predictor variables as significant in the model. Each of the five predictor variables in the model contributes to the predictive power of the regression equation. The prediction equation for the standardized variables (from predictor 1-6): Z predicted determinants of public procurement =.11+.17+.18+.25+.17 (see Table 8). The regression equation for the five predictors is significant as it relates to key determinant elements of public procurement: R square = .42, F (5, 20) = 296.155, p <.01. Furthermore, 95% confidence interval for the slopes does not have a value of zero which implies the hypothesis that one dominant determinant element underlies public procurement should be rejected at the .05 level. The result hereby points to multiple determinant elements that underlie public procurement in the public domain.

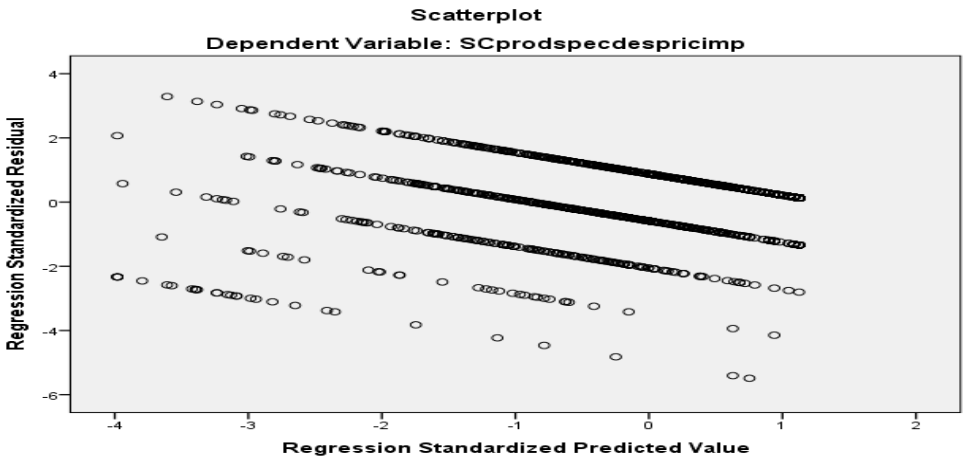

Figure 2: Shows the distribution of residual and predictor values

5.8 Model Fitness

The rationale for using multiple regression is to help establish possible best subset of predictors as key determinants for public procurement and to complement results of the factor analysis for a sound and cogent argument. As a result, relevant predictor variable per identified elements of public procurement is selected. The selection of predictors per element of public procurement enhances the explanatory power of the predictor variables and help prevent the problem of multicollinearity among the variables. The selected five predictor variables from the factor loadings (factor 1-5) based on their relevance to public procurement are: analytical techniques, negotiation strategies and techniques; techniques to ensure supplier compliance to specifications; common procurement performance measurement criteria; and ordering process. These variables are used for the regression analysis which yield the following model: Z predictor key determinant elements of public procurement =.11+.17+.18+.25+.17 (see Table 8). The analysis yields statistically significant result based on coefficient of regressions ($p < .01$). Furthermore, the model yields an R square of .424 which connotes 42% of the variance is explained. The plot of the predictor variables and criterion variable shows a fall in horizontal band around zero (see Figure 2) and the distribution of the residual is about normal with zero means. The plot thereby points to an adequate model fit.

6. Discussion

Public procurement, even though it appears emergent as an academic field of study, has been around since time immemorial. Attempts by governments at any level to meet needs and expectations of citizens' hinge on acquiring relevant goods and services, and exerting related efforts which is the domain of public procurement. In fact, public procurement occupies a unique space in governance of peoples' affairs as exemplified by the extent of GDP per capita spent by developed and developing economies within the range of 20%-50% annually (Snider & Rendon, 2012; Snider, 2006; McCue & Gianakis, 2001; Thai, 2001; Gordon, Zemansky, & Sekwat, 2000). And despite the muddled definition of public procurement (Lee & Dobler, 1977; Prier & McCue, 2009), there are some commonly identified task elements that relate procurement functions. This study aims to methodologically explore possible key determinant element(s) of public procurement based on the analysis of the Universal Public Procurement Certification Council (UPPCC) 2012 survey dataset. The study uses the hypothesis that one key dominant determinant element underlies public procurement. The study relies on factor analysis and multiple linear regression to effectively ascertain the elements for analysis and interpretation of findings.

As a data reduction technique, factor analysis was used to help identify key determinant elements of public procurement. In an attempt to determine number of factors to rotate, three criteria were used: the a priori hypothesis that one key dominant determinant element underlies public procurement; the scree test, and the interpretability of the factor solutions. The scree plot suggested the one key dominant determinant element hypothesis cannot be supported. Based on the output, the authors explored four, five and six factor rotations using Varimax rotation procedure, but eventually decided to opt for a six factor rotation for better labeling and interpretation purposes. The rotation converged in 7 iterations but was divided into six categories for presentation purposes and consisted of 40 statements measuring the various elements of public procurement.

The rotated solutions as presented in Table 2 yielded six interpretable factors. The variables with high loaded values per element of the rotated factor solution contributed the most to the variance explained by each

factor. The loading of the variables per factor from Factors 1-6 were as follows: 8;8;8;5;8; & 3 variables. Factor I accounted for 18% of the variance; Factor 2 accounted for 16% of the variance; Factor 3 accounted for 11% of the variance; Factor 4 accounted for 11% of the variance; Factor 5 accounted for 10% of the variance, and Factor 6 accounted for 6% of the variance. Together, the six factor solutions explained 72% of the variance.

The interpretation of the variables were based on the size of the factor loading. Factors 1-6 were respectively named as strategic procurement planning; contract administration; procurement administration; supply management; sourcing; and negotiation process. The names are in consonance with the original elements of public procurement as contained in the UPPCC survey instrument. Per the loading, the factors converged into three clusters: cluster 1 consisted of strategic procurement planning and contract administration which accounted for 34% of the variance; cluster 2 consisted of procurement administration, supply management, and sourcing which accounted for 32% of the variance, and cluster 3 consisted of negotiation process which accounted for 6% of the variance. Together, the elements explained 72% of the variance. The regression analysis further complemented the factor analysis result especially, the elements for public procurement.

As it relates to the regression analysis, relevant variables for public procurement (one per element) was selected based on knowledge of the extant literature and praxis, and the selected variables were used as predictors (see Table 6). Thus, five variables were selected to concurrently help determine their contributions to public procurement in addition to the criterion variable. The selected predictor variables were analytical techniques, negotiation strategies and techniques, ordering process, techniques to ensure supplier compliance to specifications and common procurement performance measurement; and the criterion variable was product specifications, descriptions, and prices which is a key part of sourcing. Together, these variables helped establish multidimensionality of public procurement.

The predictors in the regression model accounted for 42% of the variable variance as it relates to key determinant elements of public procurement and depicted a significant linear relationship (see Table 7). The adjusted R square of .422 suggested no overfitting of the model and hence enabled some generalization of the results. The regression equation for the five predictor variables was: R square = .42, $F(5, 20) = 296.155$, $p < .01$ and pointed to a significant relationship between the predictors and criterion variable for public procurement. Concertedly, the variables helped ascertain key determinant elements associated with public procurement.

The determinant elements as identified in this analysis complement each other as it relates to public procurement. The analysis reveals strategic procurement planning and contract administration are very critical to public procurement with procurement administration, supply management, and sourcing as important, and effective negotiation process as needed to help acquire required resources in order to achieve the public purpose. These determinant elements are inextricably intertwined to make public procurement a judicious and rewarding experience and hence establishes its multidimensionality alongside attesting to the essential role of public procurement in helping achieve the public purpose as it relates to management/administration of peoples' affairs.

7. Conclusion

Scholars over the years have conceptually explicated public procurement in a way that provides useful insight into some of the rudiments of this important subfield of public administration and certainly a key part of government undertakings. Such conceptual explications serve as a framework for academic and professional efforts to a large extent. However, the question of whether one dominant key determinant element drives public procurement is subject to debate and this paper attempts to provide some answers by methodologically exploring some conceptualized professional elements. By doing so, the paper further accentuates the role of public procurement to societal wellbeing regardless of the regime type.

There is no doubt that public procurement is such an integral part of government rationale because it occupies a unique space in meeting needs and expectations of citizens. Whether in developed or developing countries, governments spent quite a sizable chunk of their GDP on procurement as a conduit to providing much needed goods and services, and related efforts for the general wellbeing of the population. For instance, on the average, U.S. and some European countries spent at least, 20% of their gross domestic product (GDP) on public procurement with some developing countries spending as much as 50% (Snider & Rendon, 2012; Schiavo-Campo & Sundaram, 2000; Callendar & Mathews, 2000).

As an emergent viable academic area of study, public procurement is not that new, it has existed since civilization. From time immemorial, public procurement enables King, Queens, Emperors, Presidents, Prime Ministers, and Military rulers among others to acquire resources and exert related efforts in fulfilment of the social contract. However, the lack of a generally accepted definition of public procurement continuous to persist. What is apparent though is some commonalities as it relates to elements associated with public procurement professional practice. This study thereby uses data garnered by the Universal Public Procurement Certification Council (UPPCC) in 2012 to help ascertain possible key determinant elements of public procurement. The authors rely on data reduction technique-factor analysis and multiple linear regression complementarily to help relate possible key determinant element(s). The study relies on the hypothesis that one key dominant determinant

element underlies public procurement, but the results concertedly attests to multidimensionality of public procurement.

The analysis reveals strategic procurement planning and contract administration are very critical to public procurement with procurement administration, supply management, and sourcing as imperatives and effective negotiation process as necessary to help acquire required resources and with associated efforts in order to achieve the public purpose. These identified key determinant elements are interwoven and establish multidimensionality of public procurement regardless of level of government. The study equally relates public procurement as an instrument of public policy because of its multi-dimensional nature and how it entails engaging multiple stakeholders in decision making and implementation. Furthermore, the study suggests careful consideration of all relevant elements in any procurement undertakings and judicious utilization of human and material resources since public procurement remains as one of the most regulated areas of government endeavors (Nagle, 1999) and very susceptible to corruption (Mizoguchi& Quyen, 2014; Walker, 2005; Hutton, 2008; Woods, 2006; Shabbir & Anwar, 2007; Charron et al., 2017). The above notwithstanding and as it relates to conceptualization of public procurement, the challenge of developing a commonly accepted definition still persists and one wonders if having some clarity on public procurement key determinant elements will foster commonly acceptable definition either in the short and/or long term. Such an issue could be of interest to future research on the subject matter.

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