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## Abstract

**Purpose** – The purpose of this paper is to develop a consolidated framework for government e-procurement (e-GP) performance measurement based on the importance internal stakeholders attach to performance measures and metrics, providing in-depth understanding of their interest in e-GP performance.

**Design/methodology/approach** – This study is divided into two main phases: internal stakeholder identification and consolidation of performance measures and metrics. The mixed-methods approach follows semi-structured expert interviews with questionnaires collected from 413 internal stakeholders.

**Findings** – Five internal stakeholder groups were identified: management, auditors, financial officers, service users, and service support staff. Eight measures and 44 corresponding metrics were consolidated, and 21 significantly distinct performance metrics were identified from stakeholders' perceptions. As expected, financial measures were most important to financial officers, while contract management was most important to service support staff.

**Practical implications** – Although e-GP processes can vary by country, this study's approach to developing an e-GP performance measurement framework is adaptable, offering beneficial guidelines for designing e-GP performance measurement systems.

**Originality/value** – This paper goes beyond the existing literature by magnifying the internal stakeholder roles and perceptions of importance, as reflected in the consolidated e-GP performance measurement framework. The consolidation approach with theoretical references (new public management, transaction cost economics, and institutional theory) yielded comprehensive e-GP-specific performance measures and metrics, providing a rigorous approach to measuring e-GP performance.

**Keywords** Perceptions, E-government, Work performance, IT performance management

**Paper type** Research paper

## 1. Introduction

The public sector has experienced great pressure to digitally modernize and emulate private sector success. Electronic government (e-Government) initiatives have been broadly adopted; government electronic procurement (e-GP) is considered an e-Government pillar (Floropoulos *et al.*, 2010; Kassim and Hussin, 2010; Raffa and Esposito, 2006; Wirtz *et al.*, 2010). e-GP performance measurement are required to reflect achievement and/or as further improvement indicators.

Measureable e-GP outcomes are desired, as e-GP performance measurement is important for successful implementation (Henriksen and Mahnke, 2005; Settoon and

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Wyld, 2006; Vaidya *et al.*, 2006). However, literature on e-GP performance measurement has mainly focussed on financial aspects such as financial efficiency (mainly costs and savings) and financial effectiveness (costs and processes), as transaction cost economics theory (TCE) (Williamson, 1975) has been the rationale for e-GP adoption. Since the government affairs goals are often beyond mere profitability, it must be asked whether e-GP performance measurement should include other aspect(s).

Public operations performance is a crucial aspect of the new public management (NPM) philosophy (Hood, 1991). NPM aims to enhance public sector performance by creating an entrepreneurial environment in which employees' (internal stakeholders') opinions are valued since they are knowledgeable about and impacted by existing problems (Freeman, 1984; Osborne and Gaebler, 1992). Since internal stakeholders are an essential element in public sector information technology/systems (IS/IT) investment and implementation, including e-GP, and procurement services are aimed at satisfying internal customers' needs (Croom and Brandon-Jones, 2007), quality and performance measurement cannot overlook internal stakeholders (Claver *et al.*, 2001; Croom and Brandon-Jones, 2007; Stylianou and Kumar, 2000). Stakeholders' perceptions of the importance of and willingness to adopt performance measurement initiatives can be motivated via institutional forces, as supported by institutional theory (DiMaggio and Powell, 1983). However, e-GP literature in the NPM and institutional theory streams has given little attention to internal stakeholders' importance and provides no details about desirable performance dimensions, especially for non-financial dimensions.

Since each internal stakeholder has different expectations for IS/IT implementation, including e-GP (Forman *et al.*, 2007), their opinions and perceptions should be considered when crafting performance measurement initiatives (Osborne and Gaebler, 1992). Their diverse expectations can guide the development and consolidation approach to e-GP performance measures and metrics, as "performance" and "performers" are clearly defined (based on individually perceived importance), and ownership of each metric can be assigned and managed (Forman *et al.*, 2007; Parker, 2000). To achieve this, all internal stakeholders must be well focussed, included, and affiliated. However, the focus on internal stakeholders and their affiliation with e-GP performance is scattered, and the theoretical references used in consolidating the performance measurement framework could be more comprehensive to reflect e-GP performance measurement. This paper addresses three research questions:

*RQ1.* What should e-GP performance measures and metrics be, based on the importance internal stakeholders attach to them?

*RQ2.* How does each internal stakeholder perceive the importance attached to e-GP performance measures and metrics?

*RQ3.* What should the relationship be between e-GP performance measures and metrics and internal stakeholders?

This study is based on the Thai government's e-GP system, which has been ranked as one of the most advanced public e-procurement systems (Bulut and Yen, 2013). Furthermore, the hierarchical structure of Thai governmental organizations promotes the elaboration of e-GP internal stakeholders. Previous studies of Thailand's e-GP have insufficient detail regarding potential performance measures and metrics and do not focus on internal stakeholders. The first section covers background and literature. The following sections detail the methodology of identifying and classifying internal

stakeholders, and the development and consolidation of e-GP performance measures and metrics. The remaining sections contain the results and discussion, conclusion, limitations of the study, and future research opportunities, in that order.

## 2. Background and literature

Since the focus of this study is e-GP performance measurement involving internal stakeholders, the literature review will begin with e-GP performance measurement, followed by the role of internal stakeholders in e-GP performance measurement.

### *2.1 e-GP and performance measurement*

According to TCE theory (Williamson, 1975), costs incurred from the beginning to the end of each procurement transaction affect the decision to either in-house (hierarchies) or outsource (markets) the transaction to maintain competitive advantages. Therefore, "transaction technologies," including e-procurement, are widely adopted (Johnson *et al.*, 2007) to promote lower transaction costs and prices (Croom and Brandon-Jones, 2007; Sanders, 2007; Schoenherr and Mabert, 2011; Schoenherr and Tummala, 2007; Wiengarten *et al.*, 2012; Yang and Rho, 2007) through better procurement process integration and seller-buyer collaboration (Gunasekaran and Ngai, 2008; Henriksen and Mahnke, 2005; Johnson *et al.*, 2007). In the public sector, transaction cost reduction is one rationale used in adopting e-GP (Henriksen and Mahnke, 2005; Panayiotou *et al.*, 2004; Reddick, 2004; Uyarra and Flanagan, 2010). In e-GP, transaction cost is referred to as performance in terms of acquisition costs including sourcing, order placing, and order management (Croom and Brandon-Jones, 2007; Doherty *et al.*, 2013). e-GP is seen to reduce transaction costs. However, e-GP cost-related performance can be further elaborated, since it includes several sub-processes, and non-financial performance should be included.

e-GP performance measurement has both academic and practical value. However, e-GP performance management research under the "process management" in buyer perspective has not drawn much interest among scholars (Kassim and Hussin, 2010). Since no comprehensive literature on e-GP performance measurement exists, the literature in this paper was gathered from academic and non-academic sources, as Busi and Bititci (2006) recommended. Hence, an e-procurement practitioner report (Aberdeen Group, 2008), a country paper (Nordhus, 2004), and an e-GP project report (Hiyassat and Arabbyat, 2009) are included.

The e-GP performance measurement literature includes diverse performance measures and metrics. The term "efficiency" frequently indicates financial outcomes such as "cost savings" (e.g. Croom and Brandon-Jones, 2005, 2007; Joia and Zamot, 2002; Panayiotou *et al.*, 2004) and "price savings" (e.g. Croom and Brandon-Jones, 2005, 2007; Henriksen *et al.*, 2004; Joia and Zamot, 2002). "Non-financial" efficiency frequently refers to process-time savings (Panayiotou *et al.*, 2004; Rosacker and Olson, 2004). "Efficacy" commonly refers to "time saving" and "accountability" (Joia and Zamot, 2002). Lee *et al.* (2008) used "efficiency" and "transparency" but provided no details. Performance measure and metric categorization varies by author; other possible categorizations include finance/non-finance (Aberdeen Group, 2008), qualitative/quantitative (e.g. Hiyassat and Arabbyat, 2009; Leipold *et al.*, 2004; Nordhus, 2004), and technical/non-technical (e.g. Jang, 2010; Rose *et al.*, 2009). Most performance measures and metrics are finance-related because of their quantitative nature (Folan and Browne, 2005). However, non-financial measures and metrics should be elaborated

in detail and equally considered. This study appended non-financial metrics based on in-depth study and the adaptation of an industrial model (supply chain operation reference (SCOR)).

*2.2 Internal stakeholders and performance measurement of e-GP*

Internal staff can present an IS adoption challenge but are critical to its success (Smart, 2010; Wiredu, 2012), especially in public organizations (Croom and Brandon-Jones, 2005; Floropoulos *et al.*, 2010; Kamal *et al.*, 2011). Since the public sector is typically bureaucratic (Raffa and Esposito, 2006; Wiredu, 2012; Wirtz *et al.*, 2010), e-GP and other IS/IT adoption usually meets with difficulties attributable to internal user human factors (Croom and Brandon-Jones, 2005; Hardy and Williams, 2008; Teo *et al.*, 2009; Zhao *et al.*, 2012). Claver *et al.* (2001) considered staff a factor shaping organizational culture and an important component of e-GP implementation success (Power, 2004).

IS/IT adoption in public sector reforms, referred as NPM technologies, is a pillar of the NPM philosophy. NPM focusses on adopting entrepreneurial concepts via business-like management tools and techniques in public operations (Essig and Batran, 2005; Hood, 1991; Osborne and Gaebler, 1992). NPM technologies, including e-GP, are widely adopted to enhance operational performance and lower costs (Andrews and Van De Walle, 2013; Cordella and Bonina, 2012; Essig and Batran, 2005; Hood, 1991; Smith, 2010; Van and Jansen, 2008). However, bureaucratic operations is inefficient and ineffective and may obstruct e-GP implementation by creating obstacles such as legal restrictions and procedural inflexibility (Essig and Batran, 2005; Henriksen *et al.*, 2004; Smart, 2010; Wirtz *et al.*, 2010). This results in slow implementation and underutilization of e-GP, leading to sub-standard e-GP performance (Alsaffar *et al.*, 2009; Davila *et al.*, 2003; Engström *et al.*, 2009; Macmanus, 2002; Wirtz *et al.*, 2010).

To achieve the desired e-GP outcomes, the environment should include consolidated e-GP performance measures and metrics with corresponding performers (internal stakeholders) (Al-Raisi *et al.*, 2009; Andrews *et al.*, 2007; Radnor and Barnes, 2005). However, internal stakeholders' roles in and contributions to e-GP performance have received little attention in the e-GP-NPM literature. Further, detailed e-GP performance dimensions, especially non-financial dimensions, are lacking. This study addresses how the inclusion of e-GP internal stakeholders contributes to comprehensive e-GP performance measurement.

According to institutional theory (DiMaggio and Powell, 1983), three institutional forces (mimetic, coercive, and normative) can serve as motivational adoption decisions for institutional reforms (Cordella, 2007). Coercive force is an external incentive-oriented force to adopt practice(s)/solution(s), whereas normative force is professionalism/tradition oriented. Mimetic force is encouragement to emulate those who have successfully adopted the practice(s)/solution(s). Doherty *et al.* (2013) mentioned e-GP adoption as mimicking private sector success (mimetic) under national regulations (coercive), while normative force yields no significant influence within the staff network. IS/IT can also yield desirable institutional reforms with a proper user-defined context of uses; internal stakeholders are determinants of success beyond system and process adoption (Orlikowski, 1992). Regarding performance measurement initiatives, several authors have mentioned the importance of incorporating employees (internal stakeholders) as an essential pillar of e-GP implementation (Bourne *et al.*, 2003; Chalmeta *et al.*, 2012). Inclusion of and relationships with internal stakeholders ensure implementation success (Andrews *et al.*, 2007; Kaliannan *et al.*, 2009). Internal stakeholders are a deterministic element in the adoption success of both e-GP and e-GP

performance measurement. Although institutional theory has been referenced in recent e-GP literature (e.g. Costa *et al.*, 2013; Doherty *et al.*, 2013; McConnell *et al.*, 2010; Standing *et al.*, 2009), information regarding e-GP internal stakeholder(s) is still lacking. This study portrays how internal stakeholders' desire for e-GP success (as mimetic forces) can be reflected in the importance attached to e-GP performance measures and metrics.

Different internal stakeholders have different expectations and perceptions of the importance of IS/IT implementation, defined as "near-term" (procedural) for lower level(s) and "long-term" (strategic) for higher level(s) (Forman *et al.*, 2007; Kamal *et al.*, 2011). Perceptions of IS/IT performance (both systems and processes) vary as well. Most e-GP internal stakeholders mentioned in the literature are users and management, with procedural and strategic expectations/perceptions, respectively (Croom and Brandon-Jones, 2007; Jang, 2010; Kassim and Hussin, 2009; Rose *et al.*, 2009; Vaidya *et al.*, 2004). In reality, e-GP internal stakeholders tend to be more diverse. Croom and Brandon-Jones (2007) spoke of auditors and financial officers as major functional stakeholders in e-procurement, while Hardy and Williams (2008) spoke of multi-departmental involvement in e-GP, including finance and IT. Rotchanakitumnuai (2013) studied e-procurement adoption in Thailand and discovered process improvement was a determinant of employee satisfaction, leading to better e-procurement performance and beneficial returns. e-GP performance measures and metrics should be valued and driven by the appropriate internal parties (as performers) to realize the desired achievements. Ownership of each metric should be clearly assigned to internal stakeholders, and their corresponding affinity to e-GP measures and metrics is highly encouraged (Parker, 2000).

From the above reasons, a rigorous performance measurement approach to e-GP focussing on all internal stakeholders is absolutely necessary. However, the focus on e-GP internal stakeholders is still scattered in the existing literature, and performance measurement remains unconsolidated (Chomchaiya and Esichaikul, 2011). Consolidated e-GP performance measures and metrics based on both financial and non-financial theoretical references and focussed on internal stakeholders (the e-GP performance measurement framework in this study) are desired. This study proposes an e-GP performance measurement framework focussed on e-GP internal stakeholders and a consolidated, theoretically referenced approach.

## 3. Methodology

A mixed methodology is adopted, as this study is multiphase and sequentially combines qualitative and quantitative approaches (Tashakkori and Teddlie, 2010). As shown in Figure 1, this paper consists of two phases: internal stakeholder identification and e-GP performance measurement framework development (with related metrics). Qualitative analysis was employed in phase 1 to categorize e-GP

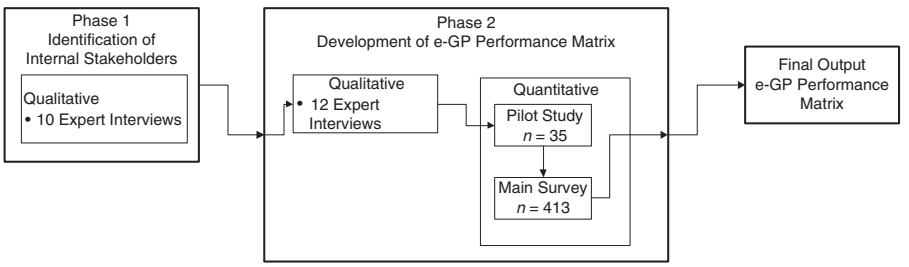


**Figure 1.**
Sequential mixed methodology

internal stakeholders (based on roles and responsibilities) before quantitative analysis to see how each attaches importance to e-GP performance aspects. Later, qualitative analysis was used to portray and explain the causal relationship between these roles and responsibilities and the rationale for attaching importance to e-GP performance.

### *3.1 Phase 1: internal e-GP stakeholder identification*

To identify internal e-GP stakeholders, the Thai government's e-GP instructions and literature were investigated, followed by in-depth interviews with experts (both academics and practitioners). Experts were selected based on their backgrounds and years of experience using a specific sampling technique. Academic experts were selected from university lecturers specialized in supply chain management, technology and innovation management, and related disciplines from public universities, who appeared to have similar backgrounds, in-depth knowledge, and recent consultative experience, and had recently been involved with Thailand's e-GP for at least five years. Practitioner experts were selected from Thai government e-GP officers/staff at both operational and supervisory levels. This was to ensure content richness by gathering opinions and viewpoints from both types of experts, leading to a complete scenario based on the different ways in which stakeholders are defined and articulated, that is, by public managerial concepts, rules, and regulations (for academics), and by procedural viewpoints and routine situational experiences (for practitioners). In-depth interviews using a semi-structured approach were preferred, with well-defined questions that provided an opportunity to elicit new information (Bryman, 2008). This step adopted Rowley's (2011) recommended method of adapting original stakeholder theory (Freeman, 1984) by identifying stakeholders based on their role(s) instead of the groups/individuals affected. The interview protocol was based on the literature and interviews with two government e-GP specialists before being cyclically peer-reviewed, pretested, and revised by five doctoral students and five students pursuing master of business administration degrees. The protocol also underwent expert reviews to validate its content.

*The interviews (semi-structured)*. Face-to-face interviews lasted around 30-45 minutes each and were digitally recorded with the interviewees' consent, or recorded in writing when so preferred. As Stam and Stanton (2010) suggested, interview questions evolved as the understanding of the control circumstances grew, but their core content remained the same. Since e-GP procedures are determined and regulated at the national level, expert opinion seemed to be homogenous. Interviews focussed on entire e-GP procedures to determine the involved parties based on their procedural role(s). Ten experts were selected and interviewed (five academics and five practitioners), and interview transcripts were extracted for frequently mentioned key terms, leading to the determination of corresponding stakeholders; these were sent to each interviewee for validation. If there was a difference in opinion, follow-up interviews were conducted until mutual agreement was reached on the internal stakeholder classification scheme. Interview results were also triangulated with other information sources, including experts from the Professional Association of Government-Supply Specialists of Thailand.

*Results of phase 1: e-GP internal stakeholders*. The findings clarified the involvement of internal stakeholders in e-GP. "Service users" and "service support staff" are obviously different groups, a fact not reflected in the reference to a single "user" in the existing literature. Service support staffs are essential, since they are the primary coordinators of e-GP and the most specialized and knowledgeable workers. Management also consists of a diverse group of employees involved in hierarchical e-GP procedural steps, compared to

the single "management" referred to in the literature. Auditors are another internal stakeholder according to several experts but are rarely mentioned in the literature. The interview transcripts were analyzed until content saturation was reached, and internal e-GP stakeholders were categorized into five groups, as shown in Table I. Detailed definitions and experts' quotations of these five groups follow.

The two types of experts yielded slightly different articulations regarding e-GP internal stakeholders: academics were conceptual and explicit, while practitioners were situational and tactical:

(1) Management: section heads, department heads, or anyone assigned managerial duties and legal responsibilities and given the authority to grant support and approval; this goes beyond the findings of the current literature. As mentioned by one practitioner:

> Beyond hierarchical authority, legal obligations are unavoidable to them. Further, policies and supports will be hierarchically transferred from the top down.

(2) Auditors: directly in charge of auditing e-GP to ensure complaint/dispute-free and legal/regulation conformance. An e-GP auditor is a specific type of auditor, as explained by a practitioner:

> e-GP auditors must be very knowledgeable and well trained and the default actors when dealing with complaints/disputes and legal issues.

(3) Financial officers: in charge of organizational cost management, financial planning, and budget appropriation, particularly related to e-GP. They are also concerned with maximum satisfaction for money spent, since they routinely deal with payment issues. One academic expert described this as follows:

> Finance persons who work with e-GP budgeting/planning must have dedicated knowledge and experience, as they deal with very particular financial issues.

(4) Service users: persons belonging to a government organization/agency; internal customers who receive services from e-GP processes. "Service user" is a common term used in e-procurement literature to mean "internal customer." One academic describes this as follows:

> Any internal person(s) required to use e-GP services (via the supply division) desires to be satisfied with the internal services and the goods/services purchased, with reasonable procedural time and complexities.

(5) Service support staff: generally "procurement officers," these are supply divisional heads, supply specialists, coordinators, or persons directly and

**Table I.** Experts interview findings regarding the overall internal stakeholders

| Internal stakeholder | Management | Auditor | Financial officers | Service user | Service support staff |
|---|---|---|---|---|---|
| Number of experts who mentioned | 10 | 8 | 7 | 10 | 10 |
| Percentage of experts who mentioned | 100% | 80% | 70% | 100% | 100% |

routinely in charge of e-GP processing and coordination and finalizing orders. One academic described the importance of this group as follows:

> Procurement officers are involved from issuing to finishing procurement orders as one of departmental rewards. They are the first ones blamed for any delays or problems and must deal with suppliers to address any problem(s).

### 3.2 Phase 2: e-GP performance measure and metric development

After internal stakeholder groups were identified, performance measures and metrics were developed. In this phase, a mixed methodology approach was adopted.

*Interview protocol.* Another interview protocol was then developed to gather primary information on performance measures and metrics for actual practices. This interview protocol was validated and reviewed as in the previous phase. However, this protocol focussed on exploring performance measures and metrics of both actual practices and potentially useful practices. The interview transcripts were validated, revised, and back-translated in the same fashion as in phase 1.

*Expert interviews.* Experts were all practitioners selected for their expertise and recent hands-on e-GP experience within the past five years, ensuring representation of all groups of internal stakeholders. Semi-structured interviews were conducted until information saturation was achieved, using procedures similar to those of the previous phase. In total, 12 experts were interviewed for 30-90 minutes each to determine the performance measures and metrics in actual practice, as well as potentially important practices, as a basis for a questionnaire. Since e-GP falls under national rules and regulations, experts' views regarding how e-GP performance should be measured were rather homogeneous because of their similar background in knowledge, training, and experience. According to Joshi and Kuhn (2007), given the exploratory nature of this phase, interviewees should not be exposed to any preconceived framework or model, in order to prevent bias. The interview questions should be carefully conveyed to avoid leading questions or misinterpretation of statements. Each interview summary was returned to the respective interviewee to validate its contents.

*Questionnaire development.* The questionnaire was developed based on the literature, expert interviews, and SCOR model. Performance measures (referred to in the SCOR model as "performance attributes") and metrics were selected from the "source" process in the "engineer-to-order" category (which remains unchanged from SCOR 6.0 (2004) to SCOR 10.0 (2010)), used at the time of this study because government procurement is not used for mass manufacturing, either for stock or to order. The original four measures (reliability, agility, responsiveness, cost) were adopted from SCOR. Three additional measures were developed based on the literature and in-depth interview results (transparency, efficiency, and effectiveness). These three additional measures were agreeable to all interviewed experts: transparency would address fairness and competitiveness in bidding, efficiency would mainly address time and price savings, and effectiveness would address satisfaction and budget movement. Eventually, seven primary measures and corresponding metrics were identified. The questionnaire was divided into three sections: respondent's categorization, perception of performance metric importance (five-point Likert scale, ranging from 5 = "very important" to 1 = "least important"), and personal information. Since the questionnaire was developed from the three above-stated sources, any repetitive items were merged and regrouped. Finally, the itemized questions

were modified to suit Thailand's e-GP system. The measures and itemized variables (metrics) in the questionnaire are shown in Table II.

Content was validated through peer review; 12 doctoral students from the fields of business and IT reviewed and commented on all measures. These steps were cyclically performed to ensure validity. Questionnaires were also circulated among experts on the subject matter, including senior academics and practitioners, for their comments, suggestions, and revisions where both academic and practical viewpoints are beneficial. Experts employed in this step were mainly those involved the previous steps to ensure subject continuity. These processes ensured the questionnaire's clarity, refinement, and correctness. The questionnaires were subsequently pilot tested and statistically analyzed for reliability.

*Data collection*. The questionnaires were distributed via two channels: individually or at an important professional event. When distributed individually, informal solicitations (phone calls) were made before issuing cover letters. A total of 150 questionnaires were distributed individually to 16 government agencies. Only 90 questionnaires were returned (60 percent response rate); 75 were completely usable. Distribution via an important professional event took place in early 2013 at a national gathering of e-GP professionals, which brought together all types of internal stakeholders. A total of 930 questionnaires were distributed, but only 625 were returned (67.2 percent response rate), of which 338 were usable. In total, 413 questionnaires were usable for statistical data analysis from both channels (75 individually distributed and 338 collected via professional event). As Armstrong and Overton (1977) recommended, questionnaires returned from both sources were *t*-tested for non-response bias, and no significant differences were encountered.

*Data analysis*. SPSS software version 16.0 was used for statistical data analysis. Initially, 35 questionnaires randomly distributed to actual e-GP stakeholders (covering all categories) were pilot tested and analyzed for reliability. After the main survey (see Figure 1), exploratory factor analysis (EFA) was conducted to extract the relevant metrics. Seven factors and 52 related itemized variables (as shown in Table II) were identified. EFA was conducted using principal component analysis (PCA) to eliminate the irrelevant variables.

Next, one-way analysis of variance (one-way ANOVA) was conducted to determine the mean differences between independent variables (groups of internal stakeholders) regarding the measures and metrics. This was to determine the differences in perception of importance of each factor (measure) and variable (metric). Least significant difference (LSD) *post hoc* analysis was used to study the differences in perception of importance among internal stakeholders at the metric level. The metrics commonly perceived as important by all five internal stakeholders were also predictable.

## 4. Findings and discussion

### *4.1 Findings*

*Questionnaire reliability*. The 35 questionnaires, which were randomly sampled but covered all groups of e-GP internal stakeholders, were pilot tested for reliability. All seven initial constructs were analyzed for reliability using Cronbach's value ($\alpha$) and their values are 0.858 (REs), 0.822 (AGs), 0.755 (RSs), 0.914 (CSTs), 0.829 (TRs), 0.708 (EFFIs), and 0.707 (EFFEs), respectively. According to Hair *et al.* (2006), all constructs are adequately reliable.

| Factor (measures) | Variable (metrics) | Item code |
|---|---|---|
| Reliability | % of suppliers contracts negotiated meeting target terms and conditions for quality, delivery, flexibility, and cost | RE1 |
| | % of orders which are completely processed | RE2 |
| | % of orders which are completely received | RE3 |
| | % of orders received w/damage | RE4 |
| | % of orders received w/defect free | RE5 |
| | % of order received on-time to demand requirement | RE6 |
| | % of orders received on-time with correct shipping document | RE7 |
| | % of order transferred completely | RE8 |
| | % of order transferred with damage free | RE9 |
| | % of order transferred on-time to demand requirement | RE10 |
| | % of order transferred w/out transaction errors | RE11 |
| | % of schedules that are changed w/in supplier's lead time to the no. of generated schedules | RE12 |
| | % of schedules generated w/in supplier's lead time to the no. of generated schedules | RE13 |
| Agility | % of the received receipts with quantity variance and need corrective actions | AG1 |
| | % of the received receipts w/out item and quality variance and need corrective action | AG2 |
| | % of sole or single source selections | AG3 |
| | Average day(s) that are affected the delivery date per each engineering change | AG4 |
| | Average day(s) that are affected the delivery date day(s) that are affected the delivery date per each schedule change | AG5 |
| | Time related to expediting the sourcing processes of procurement, delivery, receiving, and transfer | AG6 |
| | Time reduction related to expediting the transferring process | AG7 |
| | Time reduction related to source identification process | AG8 |
| Responsiveness | Average time to implement change | RS1 |
| | Receiving cycle time | RS2 |
| | Source identification cycle time | RS3 |
| | Source qualification cycle time | RS4 |
| | Source selection cycle time | RS5 |
| | Total source cycle time to completion | RS6 |
| | Transfer cycle time | RS7 |
| | Verification cycle time | RS8 |
| Cost | Cost per invoice | CST1 |
| | Product acquisition cost | CST2 |
| | Product management and planning cost as a % of product acquisition cost | CST3 |
| | Product process engineering cost as a % of product acquisition cost | CST4 |
| | Receiving and storage cost as a % of product acquisition cost | CST5 |
| | Receiving cost as a % of product acquisition cost | CST6 |
| | Sourcing cost as a % of product acquisition cost | CST7 |
| | Transfer and product storage cost as a % of product acquisition costs | CST8 |
| | Verification costs as a % of product acquisition costs | CST9 |
| | Cost reduction related to expediting the sourcing processes of procurement, delivery, receiving, and transfer | CST10 |
| | Cost reduction related to expediting the transferring process | CST11 |
| | Cost reduction related to source identification process | CST12 |

(*continued*)

**Table II.** Factors and variables for questionnaire development

| Factor (measures) | Variable (metrics) | Item code |
|---|---|---|
| Transparency | No. of complaints/disputation against TOR | TR1 |
| | % of invoice or TOR processed w/out issues or complaints | TR2 |
| | % of the selected potential suppliers who become qualified | TR3 |
| | % of qualified suppliers who meet defined requirements | TR4 |
| Efficiency | Labor cost savings | EFFI1 |
| | Tender lead time | EFFI2 |
| | % of final price difference (discount) compare to the booked price | EFFI3 |
| | Document waiting time | EFFI4 |
| Effectiveness | Appropriated budget movement | EFFE1 |
| | Satisfaction toward the quality of product/service received | EFFE2 |
| | Stakeholders' satisfaction | EFFE3 |

**Note:** Reliability, agility, responsiveness, cost, and related variables were adapted from the SCOR model

**Table II.**

*e-GP performance measures and metrics*. Data from 413 respondents were tested for factorability. The Kaiser-Meyer-Olkin indicator was 0.923, meaning the data were adequate and factorable. Factor loadings with a value ±0.5 or greater are considered necessary for practical significance (Hair *et al.*, 2006). The PCA method with varimax rotation eliminated eight variables with loadings below 0.55. All 44 remaining variables were loaded onto eight factors (as detailed in Table AI). Only the "cost" (CST) factor was separated into two new factors. Some factors were renamed, as shown in Table III.

As Table III shows, reliability was renamed "contract management," since procurement in government typically takes place through contracts. The items under this heading can be measured by the percentage of successful contracts per total number of contracts. Agility was renamed "flexibility," since the items under this heading measure responsiveness to schedule changes and the ability to expedite processes. The term "flexibility" was formerly used in SCOR, but has been readopted in this study for simplicity. Cost was separated into two new factors: "acquisition cost" (since the items under this heading refer to the acquisition cost of products and services (SCOR 6.0, 2004) and TCE (Williamson, 1975)), and "cost reduction" (since the items under this heading measure cost reduction in different aspects).

*Relationship between performance measurement and e-GP internal stakeholders*. The ANOVA results at factor levels 1-8 indicate no statistical significance between

| Factor | Factor name | Item codes |
|---|---|---|
| Factor 1 | Contract management (formerly reliability) | RE3-RE11 |
| Factor 2 | Flexibility (formerly agility) | AG4-AG8 |
| Factor 3 | Responsiveness | RS2-RS8 |
| Factor 4 | Acquisition cost (formerly cost) | CST1-CST8 |
| Factor 5 | Cost reduction (formerly cost) | CST9-CST12 |
| Factor 6 | Transparency | TR1-TR4 |
| Factor 7 | Efficiency | EFFI1-EFFI4 |
| Factor 8 | Effectiveness | EFFE1-EFFE3 |

**Note:** Items RE1, RE2, RE12, RE13, AG1, AG2, AG3, and RS1 were eliminated (factor loading $< 0.55$)

**Table III.**
Extracted factors (from EFA result)

groups of internal stakeholders ($p = 0.096$, 0.329, 0.347, 0.191, 0.348, 0.524, 0.186, and 0.216, respectively). All five internal stakeholders had similar perceptions of importance for all eight measures because they perceived e-GP as a flow-through process in which every step was important. However, LSD *post hoc* analysis (with a $p < 0.05$ significance level) was used to determine the affinity between variables (metrics) and internal stakeholders.

Through LSD, 21 variables were found to have statistically significant differences among groups of internal stakeholders. Other variables had no statistically significant differences between groups, meaning the perception of importance of those metrics was not differ among groups. The performance measures and metrics with statistically significant differences ($p < 0.05$) are individually explained in the following section. Additional statistical details for each performance measure and metric are provided in Table AII.

*Consolidation of the e-GP performance measurement framework*. The affinitive relationship between internal stakeholders and performance metrics was derived from the LSD *post hoc* analysis results. Through LSD, all five internal stakeholders were grouped by pairwise statistical significance. For example, in the pairwise comparison of "tender lead times" (metric EFFI2 under "efficiency" measures, as shown in Table AII), the mean difference for auditors is significantly lower than that for others ($p < 0.05$ and mean difference values are negative). This indicates that auditors perceived tender lead time as less important than did the other four groups, or, simply interpreted, tender lead time is important for every group except auditors. The e-GP performance measurement framework, which systematically demonstrates how internal stakeholders attached importance to or benefitted from e-GP performance measures and metrics, can be consolidated as in Table IV. As in the previous example of "Tender Lead Time," a check mark (✓) represents such a relationship. The metrics where all items are checked are equally important for all. This could serve as a beneficial guideline for practical design of e-GP performance measurement initiatives.

*Contract management*. Metrics RE3, RE4, RE7, RE8, and RE10 (based on percentage of completed orders) are perceived as more important indicators for service support staff than for auditors, because their major duty is to provide procurement services internally.

However, both service users and service support staff regarded damage-free procurement orders as more important than did auditors. Damaged orders create problems for service users and service support staff because they must confront suppliers, as mentioned above.

*Flexibility*. Financial officers perceive delivery delays (AG5) as more important than do management, auditors, and service support staff. Delivery delays can cause problems such as the imposition of penalties or lawsuits, which require complicated procedures and create undesirable situations. Delay in a single process results in an overall delay. Beyond cost and price, penalties are also considered crucial by financial officers; this also conforms to the results of phase 1. Service support staff perceived the expedition of processes (AG6) as highly important, since it is a direct indicator of their achievement of various tasks.

*Responsiveness*. Cycle time in receiving (RS2) is perceived as more important by financial officers and service support staff than by management. Additionally, the cycle time in source identification (RS3) is more important for financial officers than for management and auditors. This is because high cycle times (both RS3 and RS2) could

| | | Performance metrics | Perception of importance (by stakeholders) MGMT | AU | FO | SU | SSS |
|---|---|---|---|---|---|---|---|
| Performance measures | Contract management | % of orders which are completely received | | | | | ✓ |
| | | % of orders received w/damage | | | | | ✓ |
| | | % of orders received w/defect free | ✓ | ✓ | ✓ | ✓ | ✓ |
| | | % of order received on-time to demand requirement | ✓ | ✓ | ✓ | ✓ | ✓ |
| | | % of orders received on-time with correct shipping document | | | | | ✓ |
| | | % of order transferred completely | | | | | ✓ |
| | | % of order transferred with damage free | | | | ✓ | ✓ |
| | | % of order transferred on-time to demand requirement | | | | | ✓ |
| | | % of order transferred w/out transaction errors | ✓ | ✓ | ✓ | ✓ | ✓ |
| | Flexibility | Average day(s) that are affected the delivery date per each engineering change | ✓ | ✓ | ✓ | ✓ | ✓ |
| | | Average day(s) that are affected the delivery date per each schedule change | | | ✓ | | |
| | | Time related to expediting the sourcing processes of procurement, delivery, receiving, and transfer | | | | | ✓ |
| | | Time reduction related to expediting the transferring process | ✓ | ✓ | ✓ | ✓ | ✓ |
| | | Time reduction related to source identification process | ✓ | ✓ | ✓ | ✓ | ✓ |
| | Responsiveness | Receiving cycle time | | | ✓ | | ✓ |
| | | Source identification cycle time | | | ✓ | | |
| | | Source qualification cycle | ✓ | ✓ | ✓ | ✓ | ✓ |
| | | Source selection cycle time | ✓ | ✓ | ✓ | ✓ | ✓ |
| | | Total source cycle time to completion | ✓ | ✓ | ✓ | ✓ | ✓ |
| | | Transfer cycle time | ✓ | ✓ | ✓ | ✓ | ✓ |
| | | Verification cycle time | ✓ | ✓ | ✓ | ✓ | ✓ |
| | Acquisition cost | Cost per invoice | ✓ | ✓ | ✓ | ✓ | ✓ |
| | | Product acquisition cost | ✓ | ✓ | ✓ | ✓ | ✓ |
| | | Product management and planning cost[a] | | | ✓ | | |
| | | Product process engineering cost[a] | | | ✓ | | |
| | | Receiving and storage cost[a] | | | ✓ | | |
| | | Receiving cost[a] | | | ✓ | | ✓ |
| | | Sourcing cost[a] | ✓ | ✓ | ✓ | ✓ | ✓ |
| | | Transfer and product storage cost[a] | | | ✓ | | |
| | Cost reduction | Verification costs[a] | ✓ | ✓ | ✓ | ✓ | ✓ |
| | | Cost reduction related to expediting the sourcing processes of procurement, delivery, receiving, and transfer | ✓ | ✓ | ✓ | ✓ | ✓ |
| | | Cost reduction related to expediting the transferring process | | | ✓ | | |
| | | Cost reduction related to source identification process | | | ✓ | | |

**Table IV.**
e-GP performance matrix

(*continued*)

| | Performance metrics | Perception of importance (by stakeholders) MGMT | AU | FO | SU | SSS |
|---|---|---|---|---|---|---|
| Transparency | No. of complaints/disputation against TOR | ✓ | ✓ | | | |
| | % of invoice or TOR processed w/out issues or complaints (in specified measurement period within a fiscal year) | ✓ | ✓ | ✓ | ✓ | ✓ |
| | % of the selected potential suppliers who become qualified | ✓ | ✓ | ✓ | ✓ | ✓ |
| | % of qualified suppliers who meet defined requirements | ✓ | ✓ | ✓ | ✓ | ✓ |
| Efficiency | Labor cost savings | ✓ | ✓ | ✓ | ✓ | ✓ |
| | Tender lead time | ✓ | | ✓ | ✓ | ✓ |
| | % of final price difference (discount) compare to the booked price | ✓ | ✓ | ✓ | ✓ | ✓ |
| | Document waiting time | | | | ✓ | |
| Effectiveness | Appropriated budget movement | ✓ | ✓ | ✓ | ✓ | ✓ |
| | Satisfaction toward the quality of product/service received | ✓ | ✓ | ✓ | ✓ | ✓ |
| | Stakeholders' satisfaction | ✓ | | ✓ | | |

**Notes:** Internal stakeholders: MGMT, management; AU, auditor; FO, financial officer; SU, service user; SSS, service support staff. As % of acquisition cost

**Table IV.**

delay start and finish times, causing financial problems during budget appropriation and payments, as supported by the results of phase 1 regarding financial officers' responsibilities. A delay in cycle time could also create problems for service support staff, since this could delay the closure of the entire process.

*Acquisition cost*. Cost issues are major concerns, especially for financial officers, the stakeholders in charge. Cost of product management and planning (CST3) is perceived as more important by financial officers than by management. Financial officers attached greater importance to the cost of product process engineering (CST4) than did service users, because cost savings are a bigger concern than production processes.

Financial officers perceived the cost of receiving and storage (CST5) as more important than did service support staff, auditors, and management. Similarly, receiving cost (CST6) was perceived as more important by financial officers and service support staff than by management. Transfer and storage cost was perceived as more important by financial officers than by service support staff and service users. In government procurement, the cost of receiving, storing, and transferring tends to be greatly minimized.

*Cost reduction*. As in the case of acquisition cost measures, financial officers perceived cost reduction metrics for expedition of transfer processes and source identification processes (CST11 and CST12, respectively) as more important than did auditors. Generally, cost reduction is a major indicator of achievement and is monitored by the finance department (as mentioned in the results of phase 1) in all government agencies.

*Transparency*. The number of complaints or disputes involving terms of reference (TOR) was perceived to be more important by management and auditors than by

service support staff. In fact, once complaints or disputes arose against the TOR, the entire process must be halted or restarted, requiring management and auditors to counteract such complaints to avoid possible legal actions; this conforms to the legal responsibilities of management and auditors stated in phase 1.

*Efficiency*. Tender lead time (EFFI2) was an important metric for stakeholders except auditors, per existing literature that indicates time-related metrics are mostly mentioned in terms of non-financial efficiency. Tenders are crucial since they must be issued by service users, processed by service support staff, acknowledged by financial officers, and approved by management. Document waiting time (EFFI4) was more important for service users than for auditors, because the less the waiting time, the sooner user demands can be satisfied.

*Effectiveness*. Financial officers and management perceived stakeholder satisfaction (EFFE3) as a more important metric than did auditors. Similarly, financial officers saw stakeholder satisfaction as a considerable factor regarding the benefits and satisfaction attained from expenditure (this conforms to the results of phase 1).

Conclusively, each internal stakeholder attached to each performance measures and metric as the follow.

Management perceived all metrics for transparency measures as crucial because of their concerns regarding any transparency disputes. Similarly, effectiveness metrics were perceived as important since budget movement is a managerial concern required to be reported periodically that could affect upcoming budget appropriations. Satisfaction was important because it reflects the effectiveness of managerial policies, commitment, and support (Gunasekaran *et al.*, 2009).

Auditors perceived all transparency metrics as crucial (as did management) because of their responsibilities. Typically, auditors are independent and report directly to management; they address and counteract any transparency issue(s) in parallel with management.

Financial officers perceived all cost-related metrics as crucial since they deal with particular financial issues. All responsiveness metrics were also important for them, since cycle time directly affects costs. Similarly, effectiveness metrics were important, since timing issues directly affect budget movement, and satisfaction with spending serves as a guideline for future budgeting.

Service users perceived all efficiency metrics as important, since they are the final users of procured goods/services. Beyond the labor cost savings and final price difference perceived by others, reasonable time for tendering and document waiting are important and desirable since the sooner their demands are satisfied, the earlier they can gain access to the desired utilities.

Service support staff perceived all contract management metrics to be important because the percentage of orders at different statuses is the key departmental achievement. Most responsiveness metrics were perceived as crucial because the cycle time affects the status of in-process orders and departmental achievement. Transparency metrics were also recognized as important, since transparency is a common concern for service support staff in particular, since they are the coordinators of the e-GP process.

### *4.2 Discussion*

The answer to *RQ1* is that e-GP performance measures and metrics should be based on the perceived importance derived from internal stakeholders' roles and responsibilities in

the e-GP process, since their own benefit toward performance metrics are explicated. For example, all cost-related metrics were derived from the perceived importance based on the roles and responsibilities of e-GP financial officers, adopted from the SCOR model.

The answer to *RQ2* is that the importance each stakeholder attaches to measures and metrics varies based on how they are individually affected by or benefit from these items. For example, service support staff perceived contract management metrics as more important than did others (as departmental achievements), and financial officers perceived all responsiveness metrics as second important, next to cost-related metrics, since time issues directly affect costs. However, many metrics were perceived as important by multiple groups, revealing the possibility of mutual effects or benefits from these items.

The answer to *RQ3* is that the affinitive relationship between internal stakeholders and the importance attached to e-GP performance measures and metrics should reflect the performance aspects each stakeholder can contribute to. Metrics perceived as important by only one stakeholder imply a single contributor, while others mutually perceived as important mean possible multiple contributors.

The e-GP performance measurement framework developed in this study includes performance measures and metrics from several theoretical references (TCE, NPM, and institutional), which were statistically distilled and affiliated via the e-GP internal stakeholders' perception of importance. This resulted in a rigorous e-GP-specific performance measurement approach. Empirically, perception of importance of e-GP performance reflects the desire for e-GP success, but institutional theory can be extensively applied because the attitudes and factors affecting stakeholders' decision to adopt can be further investigated since coercive and normative forces are seen more clearly once fully implemented. e-GP internal stakeholders and their desired dimension(s) for success were magnified and reflected, which could promote successful adoption.

## 5. Conclusion and future work

e-GP performance measurement is essential for managing e-GP performance. This study adopted a mixed methodology to create a clearer scenario (Carruthers, 1990). The overall re-categorized e-GP internal stakeholders were discovered, and a distinction between "user" and "service support staff" was based on their different roles and responsibilities and their perception of the importance of e-GP performance. This is beneficial for designing a rigorous e-GP performance measurement approach, since the employed measures and metrics are more specific. This finding contrasts with the literature. Details about the "management" and "auditor" groups contribute to the e-GP literature and are beneficial in determining more specific corresponding performer(s). For example, transparency and effectiveness measures can be assigned to management and auditors, while contract management and efficiency measures can be assigned to service support staff and service users, respectively. The case of Thailand's e-GP can be the basis for further development of the more specific stakeholder-related theory for hierarchical (or monarchical) government structure. Some new metrics (especially transparency) were revealed in more detail than in the current literature and inclusively perceived as important, reflecting potential practicality. Finally, an e-GP performance measurement framework was developed based on qualitative and quantitative analysis.

Application of the industrial performance model (SCOR) to e-GP is an e-GP literature breakthrough. The former "cost" metrics were newly regrouped into "acquisition cost" and "cost reduction," and transparency metrics (rarely found in the e-GP literature)

were elaborated, focussing on bidding fairness and competitiveness. Finally, the affinitive relationship between e-GP internal stakeholders and their perceived importance of e-GP performance were portrayed, indicating the benefitted/affected stakeholders for such metrics with corresponding implications via the e-GP performance measurement framework. This approach to a performance measurement framework leads to a rigorous and comprehensive e-GP performance measurement approach, since it combines scattered performance metrics with several e-GP-related theoretical references and focusses on all internal stakeholders, which is novel in the e-GP literature.

The magnified roles of e-GP internal stakeholders in measures and metrics demonstrated how and by whom cost related and overall e-GP performance should be driven. Cost-related metrics are elaborated relative to the magnified roles and dedication of financial officers in transaction cost reduction (beyond process integration and inter-organizational collaboration). Internal stakeholders' roles in and perceptions of importance for e-GP performance are magnified beyond the sole adoption of NPM technologies. The importance attached to measures and metrics reflects the desire for e-GP success based on mimetic forces.

Practically, the e-GP performance measurement framework can be used as a master model for e-GP performance measurement initiatives in which the involved internal stakeholders (as performance drivers) can be assigned and corresponded. For example, most cost metrics and related data gathering task(s) are the main concerns of financial officers, while contract management metrics are the concern of service support staff. Overall e-GP performance can be relationally tracked, improved, and discussed with corresponding performer(s). Although e-GP processes can vary by government/country, the approach used in this study is adaptable, providing beneficial guidelines to ensure the success of e-GP performance measurement through greater supportive cooperation and lower resistance.

The scope of this study is limited to internal government buyer stakeholders, but could be expanded to crucial external stakeholders (e.g. sellers/suppliers). A study to confirm this study's results, or to adapt them to other performance measurement frameworks, could be conducted. A comparison of the results for internal and external stakeholders could guide both early and late adopters of e-GP.

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(The Appendix follows overleaf.)

## Appendix

| Variables | Factor 1 | Factor 2 | Factor 3 | Factor 4 | Factor 5 | Factor 6 | Factor 7 | Factor 8 |
|---|---|---|---|---|---|---|---|---|
| *Reliability (RE)* | | | | | | | | |
| % of orders which are completely received (RE3) | 0.716 | | | | | | | |
| % of orders received w/damage (RE4) | 0.710 | | | | | | | |
| % of orders received w/defect free (RE5) | 0.740 | | | | | | | |
| % of order received on-time to demand requirement (RE6) | 0.781 | | | | | | | |
| % of orders received on-time with correct shipping document (RE7) | 0.771 | | | | | | | |
| % of order transferred completely (RE8) | 0.784 | | | | | | | |
| % of order transferred with damage free (RE9) | 0.779 | | | | | | | |
| % of order transferred on-time to demand requirement (RE10) | 0.796 | | | | | | | |
| % of order transferred w/out transaction errors (RE11) | 0.759 | | | | | | | |
| *Agility (AG)* | | | | | | | | |
| Average day(s) that are affected the delivery date per each engineering change (AG4) | | | | 0.720 | | | | |
| Average day(s) that are affected the delivery date day(s) that are affected the delivery date per each schedule change (AG5) | | | | 0.715 | | | | |
| Time related to expediting the sourcing processes of procurement, delivery, receiving, and transfer (AG6) | | | | 0.631 | | | | |
| Time reduction related to expediting the transferring process (AG7) | | | | 0.724 | | | | |
| Time reduction related to source identification process (AG8) | | | | 0.672 | | | | |
| *Responsiveness (RS)* | | | | | | | | |
| Receiving cycle time (RS2) | | | 0.565 | | | | | |
| Source identification cycle time (RS3) | | | 0.598 | | | | | |
| Source qualification cycle (RS4) | | | 0.593 | | | | | |
| Source selection cycle time (RS5) | | | 0.703 | | | | | |
| Total source cycle time to completion (RS6) | | | 0.705 | | | | | |
| Transfer cycle time (RS7) | | | 0.693 | | | | | |
| Verification cycle time (RS8) | | | 0.617 | | | | | |
| *Cost* | | | | | | | | |
| Cost per invoice (CST1) | | 0.593 | | | | | | |
| Product acquisition cost (CST2) | | 0.752 | | | | | | |

**Table AI.**
Exploratory factor analysis results

(*continued*)

| Variables | Factor 1 | Factor 2 | Factor 3 | Factor 4 | Factor 5 | Factor 6 | Factor 7 | Factor 8 |
|---|---|---|---|---|---|---|---|---|
| Product management and planning cost as a % of product acquisition cost (CST3) | | 0.758 | | | | | | |
| Product process engineering cost as a % of product acquisition cost (CST4) | | 0.814 | | | | | | |
| Receiving and storage cost as a % of product acquisition cost (CST5) | | 0.792 | | | | | | |
| Receiving cost as a % of product acquisition cost (CST6) | | 0.788 | | | | | | |
| Sourcing cost as a % of product acquisition cost (CST7) | | 0.683 | | | | | | |
| Transfer and product storage cost as a % of product acquisition costs (CST8) | | 0.602 | | | | | | |
| Verification costs as a % of product acquisition costs (CST9) | | | | | 0.637 | | | |
| Cost reduction related to expediting the sourcing processes of procurement, delivery, receiving, and transfer (CST10) | | | | | 0.726 | | | |
| Cost reduction related to expediting the transferring process (CST11) | | | | | 0.795 | | | |
| Cost reduction related to source identification process (CST12) | | | | | 0.751 | | | |
| *Transparency (TR)* | | | | | | | | |
| No. of complaints/disputation against TOR (TR1) | | | | | | | 0.714 | |
| % of invoice or TOR processed w/out issues or complaints (in specified measurement period within a fiscal year) (TR2) | | | | | | | 0.719 | |
| % of the selected potential suppliers who become qualified (TR2) | | | | | | | 0.786 | |
| % of qualified suppliers who meet defined requirements (TR4) | | | | | | | 0.739 | |
| *Efficiency* | | | | | | | | |
| Labor cost savings (EFFI1) | | | | | | 0.753 | | |
| Tender lead time (EFFI2) | | | | | | 0.787 | | |
| % of final price difference (discount) compare to the booked price (EFFI3) | | | | | | 0.809 | | |
| Document waiting time (EFFI4) | | | | | | 0.693 | | |
| *Effectiveness* | | | | | | | | |
| Appropriated budget movement (EFFE1) | | | | | | | | 0.692 |
| Satisfaction toward the quality of product/service received (EFFE2) | | | | | | | | 0.751 |
| Stakeholders' satisfaction (EFFE3) | | | | | | | | 0.756 |

**Note:** Variables with loadings below 0.55 are eliminated for clarity and factors' names are original

**Table AI.**

| Item code | Description | (I) Stakeholder | (J) Stakeholder | Mean diff (I–J) | *p*-value |
|---|---|---|---|---|---|
| *Contract management* | | | | | |
| RE3 | % of orders completely received | Service support staffs | Management | 0.245 | 0.071 |
| | | Service support staffs | Auditors | 0.325 | 0.016* |
| | | Service support staffs | Financial officers | 0.159 | 0.229 |
| | | Service support staffs | Service user | 0.248 | 0.064 |
| RE4 | % of orders received w/damage | Service support staffs | Management | 0.066 | 0.644 |
| | | Service support staffs | Auditors | 0.399 | 0.017* |
| | | Service support staffs | Financial officers | 0.114 | 0.410 |
| | | Service support staffs | Service user | 0.178 | 0.207 |
| RE7 | % of orders received on-time with correct shipping document | Service support staffs | Management | 0.072 | 0.599 |
| | | Service support staffs | Auditors | 0.331 | 0.015* |
| | | Service support staffs | Financial officers | 0.141 | 0.284 |
| | | Service support staffs | Service user | 0.214 | 0.112 |
| RE8 | % of order transferred completely | Service support staffs | Management | 0.141 | 0.311 |
| | | Service support staffs | Auditors | 0.353 | 0.011* |
| | | Service support staffs | Financial officers | 0.146 | 0.279 |
| | | Service support staffs | Service user | 0.057 | 0.676 |
| RE9 | % of order transferred with damage free | Auditors | Management | −0.254 | 0.149 |
| | | Auditors | Financial officers | −0.294 | 0.089 |
| | | Auditors | Service user | −0.410 | 0.019* |
| | | Auditors | Service support staff | −0.396 | 0.004* |
| RE10 | % of order transferred on-time to demand requirement | Service support staffs | Management | 0.047 | 0.734 |
| | | Service support staffs | Auditors | 0.342 | 0.013* |
| | | Service support staffs | Financial officers | 0.088 | 0.509 |
| | | Service support staffs | Service user | 0.126 | 0.353 |
| *Flexibility* | | | | | |
| AG5 | Average day(s) that are affected the delivery date day(s) per each schedule change | Financial officers | Management | 0.464 | 0.010* |
| | | Financial officers | Auditors | 0.415 | 0.020* |
| | | Financial officers | Service users | 0.233 | 0.189 |
| | | Financial officers | Service support staffs | 0.289 | 0.039* |
| AG6 | Time related to expediting the sourcing processes of procurement, delivery, receiving, and transfer | Service support staffs | Management | 0.301 | 0.025* |
| | | Service support staffs | Auditors | 0.138 | 0.300 |
| | | Service support staffs | Financial officers | −0.020 | 0.876 |
| | | Service support staffs | Service users | 0.057 | 0.664 |
| *Responsiveness* | | | | | |
| RS2 | Receiving cycle time | Management | Auditor | −0.163 | 0.325 |
| | | Management | Financial officers | −0.448 | 0.006* |
| | | Management | Service user | −0.3 | 0.069 |
| | | Management | Service support staff | −0.358 | 0.006* |
| RS3 | Source identification cycle time | Financial officers | Management | 0.301 | 0.025* |
| | | Financial officers | Auditor | 0.138 | 0.300* |
| | | Financial officers | Service user | −0.02 | 0.876 |
| | | Financial officers | Service support staff | 0.057 | 0.664 |
| *Acquisition cost* | | | | | |
| CST3 | Product management and planning cost | Financial officers | Management | 0.366 | 0.024* |
| | | Financial officers | Auditors | 0.161 | 0.317 |

**Table AII.**
*Post hoc* analysis results (least significant difference (LSD)) of all factors

(*continued*)

| Item code | Description | (I) Stakeholder | (J) Stakeholder | Mean diff (I–J) | *p*-value |
|---|---|---|---|---|---|
| | | Financial officers | Service users | 0.311 | 0.053 |
| | | Financial officers | Service support staffs | 0.149 | 0.237 |
| CST4 | Product process engineering cost | Financial officers | Management | 0.269 | 0.110 |
| | | Financial officers | Auditors | 0.144 | 0.390 |
| | | Financial officers | Service users | 0.331 | 0.047* |
| | | Financial officers | Service support staffs | 0.214 | 0.102 |
| CST5 | Receiving and storage cost | Financial officers | Management | 0.392 | 0.016* |
| | | Financial officers | Auditors | 0.381 | 0.018* |
| | | Financial officers | Service users | 0.294 | 0.067 |
| | | Financial officers | Service support staffs | 0.25 | 0.048* |
| CST6 | Receiving cost | Management | Auditor | −0.149 | 0.362 |
| | | Management | Financial officers | −0.433 | 0.007* |
| | | Management | Service users | −0.196 | 0.228 |
| | | Management | Service support staffs | −0.27 | 0.037* |
| CST8 | Transfer and product storage cost | Financial officers | Management | 0.313 | 0.060 |
| | | Financial officers | Auditors | 0.304 | 0.067 |
| | | Financial officers | Service users | 0.353 | 0.033* |
| | | Financial officers | Service support staffs | 0.324 | 0.013* |
| *Cost reduction* | | | | | |
| CST11 | Cost reduction related to expediting the transferring process | Financial officers | Management | 0.129 | 0.448 |
| | | Financial Officers | Auditors | 0.34 | 0.045* |
| | | Financial officers | Service users | 0.197 | 0.243 |
| | | Financial officers | Service support staffs | 0.219 | 0.099 |
| CST12 | Cost reduction related to source identification process | Financial officers | Management | 0.366 | 0.030* |
| | | Financial officers | Auditors | 0.455 | 0.007* |
| | | Financial officers | Service users | 0.253 | 0.129 |
| | | Financial officers | Service support staffs | 0.271 | 0.039* |
| *Transparency* | | | | | |
| TR1 | Number of complaints or disputation against TOR | Service support staffs | Management | −0.357 | 0.016* |
| | | Service support staffs | Auditors | −0.371 | 0.012* |
| | | Service support staffs | Financial officers | −0.117 | 0.417 |
| | | Service support staffs | Service users | −0.097 | 0.504 |
| *Efficiency* | | | | | |
| EFFI2 | Tender lead time | Auditors | Management | −0.331 | 0.047* |
| | | Auditors | Financial officers | −0.378 | 0.021* |
| | | Auditors | Service users | −0.413 | 0.012* |
| | | Auditors | Service support staff | −0.398 | 0.002* |
| EFFI4 | Document waiting time | Auditors | Management | −0.225 | 0.141 |
| | | Auditors | Financial officers | −0.219 | 0.196 |
| | | Auditors | Service users | −0.409 | 0.017* |
| | | Auditors | Service support staff | −0.255 | 0.060 |
| *Effectiveness* | | | | | |
| EFFE3 | Stakeholders' satisfaction | Auditors | Management | −0.495 | 0.006* |
| | | Auditors | Financial officers | −0.459 | 0.009* |
| | | Auditors | Service users | −0.313 | 0.079 |
| | | Auditors | Service support staffs | −0.255 | 0.071 |

**Notes:** Metrics with no statistical significance are not displayed for clarity. *The mean difference is significant at 0.05 level

**Table AII.**

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