

Implementation of Robotic Process Automation in Public Sector Goods and Services e-Procurement Audit

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Abstract

Indonesia has adopted e-Procurement through an electronic procurement system (SPSE) implemented by the Electronic Procurement Service to improve transparency and efficiency in procuring goods and services (LPSE). Although the data/information presented in the LPSE is easily accessible, using the data in the LPSE for supervisory or audit functions is still not optimal. However, procurement of goods and services is the area with the highest corruption cases in Indonesia. The large amount of data in LPSE makes the audit process difficult because there is too much data to consider, especially if the audit process is still manual. As a result, auditors must use information technology to aid audit activities, also known as Computer Assisted Audit Techniques (TABK). In the field of public procurement auditing, the methodology for extracting large amounts of information is also unknown. Robotic Process Automation (RPA), which is thought to have great potential to facilitate audit work, is one of the information technologies that can help extract large amounts of data. The author attempts to investigate the implementation of RPA in the audit of the public sector's procurement of goods and services by using qualitative research methods that were analyzed descriptively in this study. The study's findings show that process automation can be done well and produce data that can be used in audits.

Keywords: Audit, DEA, e-procurement, GAS, TABK

Abstrak

Dalam rangka meningkatkan transparansi dan efisiensi pengadaan barang dan jasa, Indonesia telah mengadopsi E-Procurement melalui Sistem Pengadaan Secara Elektronik (SPSE) yang dilaksanakan oleh Layanan Pengadaan Secara Elektronik (LPSE). Data/informasi yang tersaji dalam LPSE mudah diakses, sayangnya penggunaan data di LPSE untuk fungsi pengawasan atau audit masih belum optimal padahal pengadaan barang dan jasa merupakan bidang dengan kasus korupsi tertinggi di Indonesia. Data yang sangat banyak di LPSE menyulitkan proses audit karena terlalu banyak data yang harus diperhatikan terutama jika proses audit masih manual. Untuk itu auditor perlu menggunakan teknologi informasi untuk membantu kegiatan audit atau yang dikenal dengan Teknik Audit Berbantuan Komputer (TABK). Metodologi untuk mengekstraksi informasi berjumlah besar juga belum dikenal dengan baik dalam bidang audit pengadaan publik. Salah satu teknologi informasi yang dapat membantu proses ekstraksi data dengan jumlah yang besar adalah Robotic Process Automation (RPA) yang dipercaya memiliki potensi besar untuk memudahkan pekerjaan audit. Dalam penelitian ini penulis mencoba mengeksplorasi bagaimana penerapan RPA dalam audit pengadaan barang dan jasa pada *sector public* dengan menggunakan metode penelitian kualitatif yang dianalisa secara deskriptif. Hasil penelitian menunjukkan bahwa otomasi proses bisa dilakukan dengan baik dan menghasilkan data yang dapat digunakan dalam audit.

Kata kunci: Audit, DEA, e-procurement, GAS, TABK

INTRODUCTION

Public procurement is one sector that needs attention in good governance because it is directly related to the expenditure of public funds. Public procurement is a core instrument for achieving efficient management of public resources. The procurement process starts from planning, procurement preparation, procurement/tender (through self-management or supplier selection), contract execution, and handover of goods/services. The activities included in the above process include identifying needs, conducting market analysis, qualifying providers, conducting tenders, evaluating providers, determining winners, and executing contracts, and handovers.

E-procurement modifies the acquisition of products and services so that all operations, from identification to payment, are conducted electronically. In numerous nations, e-procurement has been implemented to promote government transparency and efficiency and eliminate corruption. The government of Indonesia is one of the nations that employ e-procurement to acquire products and services. According to the findings of Rotchanakitumnuai's research, having a transparent electronic procurement process encourages good governance practices, raises cost-effectiveness and accountability, and decreases the likelihood of supplier collusion. (Rotchanakitumnuai, 2013). Despite the findings of a study that investigated the efficacy of e-procurement, there is still a significant amount of corruption involved in purchasing goods and services in Indonesia. This is the case despite the findings of the study. The Corruption Eradication Commission (KPK) had dealt with 775 cases of bribery and 266 cases of the acquisition of goods and services by the time 2021 rolled around. Despite the widespread adoption of electronic auctions, there have been multiple instances of bribery involving purchasing goods or services. (Corruption Eradication Commission, 2021). This demonstrates that the use of electronic auctions has not prevented corruption. According to Ishii's research, the effect of implementing e-procurement is diminished when bidders are likely to reside in the same community, which permits communication between bidders; hence, bidder collusion remains possible (Ishii, 2022).

The Electronic Procurement System, abbreviated as SPSE, is a decentralized e-procurement system in Indonesia that LKPP designed. This system is used to implement e-procurement in Indonesia (Policy of the Government Procurement Agency) through Layanan Pengadaan Secara Elektronik (LPSE). According to the Indonesian national procurement portal, there are 683 LPSEs in Indonesia, including 71 LPSEs of State Ministries/Institutions, 525 LPSEs of Provincial/City/Regional Governments, and 87 LPSEs of Higher Education/Hospitals/Other Agencies. In addition, Government Goods/Services Procurement Policy Institute (LKPP) smart report data indicates that there are currently 620 LPSE system providers and 15 LPSE service providers.

Electronic auction (e-auction) is a type of electronic procurement that has experienced tremendous growth since its inception in 2008, with many packages and a relatively high package maximum value each year. According to data from the LKPP's General Procurement Plan Information System (SIRUP), 109,914 e-auction packages with a maximum weight of over 423 trillion were registered in 2022 alone.

One of the benefits of LPSE is that open data can be accessed by anyone other than bidders, tender committees, and government auditors. Because each party can monitor irregular behavior that indicates fraud in the procurement of government goods and services, open access is expected to increase transparency. However, the use of LPSE data for supervision or auditing is inefficient. Many tenders and bidders complicate the audit process due to limited audit resources and too much data to pay attention to.

The process for retrieving vast quantities of data in auditing public procurement is not well-known. The public and government auditors have not generally adopted technology that can facilitate recovering data from LPSE. It is considered that Robotic Process Automation (RPA) has the potential to enable audit

work. However, most research is still at the conceptual level and has not offered evidence on the notion of RPA deployment for limited-scope audits.

This research will investigate how the implementation of RPA in the audit of the procurement of goods and services in the public sector extracts information from the LPSE. The data is then converted, analyzed, and presented as electronic data that can serve as potential audit objectives and sufficient and competent audit evidence in implementation audits. This paper describes the formulation of the issue as follows: 1. What information may be accessed from the LPSE website using RPA?; 2. How can RPA facilitate retrieving data from the LPSE web?; 3. How can data from the LPSE online be transformed into information that can be utilized in audits?; and 4. How can RPA detect symptoms of noncompliance with the purchase of goods and services through the tender process?

Based on the problems identified above, the objectives of this study are: 1. Determine what data may be accessed using RPA from the LPSE online; 2. Determine how data retrieval from the LPSE web is performed using RPA; 3. Determine how to transform data from the LPSE site into relevant information that can be used for audits; and 4. Determine how RPA can identify signals of noncompliance with the procurement process for goods and services.

RESEARCH METHOD

The study methodology employed is descriptive analysis. Descriptive research aims to describe or provide an overview of the object of investigation using as-collected data or samples without interpreting or drawing broad conclusions (Sugiyono, 2015).

In this study, the author will present the method of discovering possible fraud in the Regional Government of West Java Province's procurement of goods and services using RPA by analyzing data on purchasing commodities at LPSE. This research focuses on the RPA auditing the public sector e-procurement of goods and services at the West Java LPSE.

This study was conducted via a census since the data collected represented the total population and not a representative group. In this study, the population consisted of all West Java Provincial Government offices that purchased products and services via E-Procurement via LPSE between 2017 and 2021.

RESULTS AND DISCUSSION

Result

Robotic Process Automation (RPA)

In the worldwide banking and accounting industries, Robotic Process Automation (RPA) is an emerging technology. Implementing RPA primarily increases productivity and insourcing. RPA does not entail that every task is given to a computer. People should participate in RPA as a hybrid workforce comprised of human and computer workers (Leivonen, 2019). RPA is a promising new development beginning to affect business (Lhuer, 2016) substantially.

Accounting initially transitioned from paper to computer-assisted work and then swiftly to electronic systems due to the advancement of hardware and software. The development of computer networks and software facilitated the transport of machine-readable data across computer systems, marking the beginning of automation. Utilizing software and automation boosts productivity by enabling the efficient management of enormous transaction volumes. (Vilminko-Heikkinen & Pekkola, 2017)

The process automation revolution is the next industrial revolution. The origins of RPA can be traced back to web page scraping and workflow automation systems from the 1990s, whereas the phrase RPA, dates back to the early 2000s. (Ostdick, 2016). RPA robots are not physical. They are described as "virtual people that are infinitely scalable and can be programmed to conduct operational operations at machine speed." RPA is ideal for jobs involving data input from one system, data transformation based on structured rules, and data transfer to another computer system. For instance, data gathered from emails or websites may be transformed into an Excel file and sent to the ERP system. RPA enables process automation without modifying current information systems because robots utilize the same programs in the exact locations and the same manner as humans.

According to a recent examination of emerging technologies by McKinsey & Company (Ostdick, 2016), automation technologies such as RPA may have an economic impact of approximately \$6.8 trillion by 2025. It is predicted to have the second-largest financial implications among developing technologies, behind the introduction of mobile internet for smartphones and tablets. Therefore, it is apparent that RPA is expanding rapidly and becoming one of the most critical technology platforms and business standards.

RPA in Audit

The Indonesian Government Association of Internal Auditors (AAIPI) defines an audit as a process of problem identification, analysis, and evaluation of evidence conducted objectively, professionally, and independently to evaluate the truth, accuracy, credibility, effectiveness, efficiency, and dependability of information on the implementation of government agency responsibilities and functions. An audit is a process of gathering and assessing evidence regarding quantifiable information, performed by an impartial and qualified individual to determine and report the information's conformance with predetermined standards (Arens et al., 2019). According to Hayes et al. (2015), auditing is a systematic way of acquiring and analyzing evidence that is conducted independently, objectively, and professionally to assess the dependability of the audit's underlying facts.

Based on the preceding definitions, it can be inferred that an auditor's responsibility is to collect and assess evidence to determine the applicability and reliability of the information concerning predetermined criteria. It is common to refer to audit evidence as data or information. Information or audit evidence can be obtained from the LPSE web to audit public procurement tenders in Indonesia. However, the large amount of data available on the LPSE makes manual analysis impossible, especially with limited audit time and personnel; as a result, auditors need to consider using computer-assisted audit techniques.

The computer-assisted audit technique (TABK) applies computers to audit tasks (Praktiyasa & Widhiyani, 2016). Romney stated that TABK is using a computer to perform an audit function, which can facilitate auditing (Romney, 2015). TABK can be utilized if there is a time constraint on the audit, allowing it to be bypassed, provided the auditor has the competence and ability to process data electronically (Muhayoca & Ariani, 2017). TABK can improve the effectiveness and efficiency of audits, enabling auditors to do 100 percent population testing (Singleton, 2011). The benefits of using TABK in audits include detecting atypical samples to detect fraud, collecting, analyzing, and reporting company data, and managing a large amount of data in a short period (Sebiat, 2021).

TABK is frequently related to data mining, extraction, and analysis (Singleton, 2011). Data Extraction and Analysis (DEA) is one of the TABK procedures used to retrieve or extract data or information from an audit object for further analysis by the auditor (Darono, 2010). Typically, this technique is implemented using software explicitly designed for auditing, although over time, it can also be applied using software not intended for auditing operations. RPA is a technology that can be utilized to

execute DEA procedures. This study will describe how to apply RPA in using DEA techniques as part of computer-based audit techniques, particularly for auditing the Regional Government of West Java Province's purchase of goods and services.

TABK is adaptable enough to be utilized in either control or substantive testing. Generalized Audit Software (GAS) is one of the tools that may be used to carry out substantive testing, particularly when the DEA methodology is being applied. Another tool that can be used is the DEA. Because the testing procedure frequently reprocesses the application's output to ascertain whether the result fulfills preset test criteria, GAS is an example of an indirect testing approach. (Darono, 2010). Excel, Audit Command Language (ACL), MySQL, and Microsoft Access are some of the most common GAS tools (Rufandi, 2020).

Previous studies (Darono, 2010; Febrian, 2018) have examined the applicability of Microsoft Excel for DEA/GAS. Microsoft Excel is an excellent tool for DEA/GAS. This study will investigate using RPA in DEA/GAS and Microsoft Excel to process data acquired from RPA. The method used in this research is the case study method (Kuswarno, 2009). As expressed by Deddy Mulyana, the case study in question is a comprehensive description and explanation of various aspects of an individual, a group, an organization (community), a program, or a social situation.

Extractable data from the LPSE web

In 2014, 683 LPSEs and hundreds of thousands of auctions were held in Indonesia, according to the introduction. Since all LPSE websites utilize the same system, choosing a website that provides an overview of the retrievable data is possible. This study selected one of the LPSE websites maintained by the province administration of West Java. This LPSE has conducted tens of thousands of procurements with hundreds of thousands of participants. Access to the West Java Provincial Government LPSE website is available at <https://lpse.jabarprov.go.id>.

The intent of the data analysis determines the data selection for processing. In general, the information that will be retrieved from these LPSE data will include the number of tenders conducted each year, the number of unsuccessful and successful tenders, monetary value, tender participants, the number of tenders in which the company participated, and the number of winning bids. Information on the number of unsuccessful and successful tenders is crucial so that internal auditors may identify vital areas in the procurement of goods and services, examine the difficulties, and make recommendations for improving the tender implementation process from planning to execution. The quantity of unsuccessful bids indicates a lack of internal control and structure in the institution's procurement of products and services. The larger the failure, the less efficiently the acquisition of goods and services is being carried out, and the lower the performance of budget absorption.

The number of bidders and successful bids can also enhance the tender system and the internal auditing procedure. The electronic tender system was developed to encourage efficiency and information transparency as part of implementing governance. The method ensures that the procurement of goods and services is conducted efficiently. Inconsistencies in bids may be indicative of probable fraud.

Data extraction using RPA

The task of the RPA consists of:

- a. Web scraping: data on types of tenders, the status of tender stages, list of companies participating in tenders, and list of tender winners.
- b. Data cleaning
- c. Data processing

d. Summary/data visualization

On the very first page of the tender document, you will find information regarding the type of tender, the name of the organization that is hosting the tender, the year that the tender was held, and the name of the successful organization. The database that stores the tender data also contains the tender ID, the name of the package, the phases, and the projected cost. If you click on the name link for the box, you will be able to have access to the complete report that pertains to each offer. Acquiring these linkages from within Microsoft Excel is feasible by using the Visual Basic for Applications (VBA) function. The database that stores the tender data also contains the tender ID, the name of the package, the phases, and the projected cost. If you click on the name link for the box, you will be able to have access to the complete report that pertains to each offer. Acquiring these linkages from within Microsoft Excel is feasible by using the Visual Basic for Applications (VBA) function. This link's five tender detail tabs can be used to produce data that this link's base can use. You may use this link to get further information.

Web scraping is a technique used to retrieve data. This technique can be accomplished with various tools, including Python, UIPath, and Microsoft Excel. After the data has been successfully recovered by web scraping, then the data is processed to get the coefficients of descriptive statistics. This procedure involves removing unneeded information from data. For instance, data on ceiling pricing and HPS are formatted using monetary symbols, a delimiter, and a comma delimiter. All three must be eliminated from the recorded data to execute algebraic operations on the numbers and produce descriptive statistics.

It is necessary to eliminate redundant data, for example, on the names of companies participating in the tender. This process must be carried out so that later it can be checked for the presence of the company uniquely in each tender. Additionally, an examination of the winner is also carried out on the company's name. This check is essential to calculate the number of times the company has participated in the tender and the number of winning bids. As mentioned previously, the details of each bid are presented in the tab accessible via the homepage link. (1) The first tab is the announcements section. This tab covers segments such as the type of procurement, the price range, the bidder criteria, and the number of bidders. (2) The following tab contains a list of bidders' names, NPWP, and bid values. (3) The third tab covers the findings of the administrative evaluation, technical evaluation, qualification evaluation, qualification verification, price/cost evaluation, winner evaluation, and contract winner evaluation. (4) The fourth tab includes the winner's information, including name, TIN, address, and the agreed-upon price. (5) The final tab contains the contracted winner's name. Figure 1 to figure 5 illustrate the information on the cover web page and the tender's specifics.

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The screenshot shows the LPSE (Lembaga Kebijakan Pengadaan Barang/Jasa) homepage. At the top, there is a navigation bar with options like BERANDA, CARI PAKET, REGULASI, etc. Below this is a search area with filters for 'Jenis Pengadaan' (Semua), 'Tahun Anggaran' (2020), and 'Nama K/L/PD' (Pemerintah Daerah Provinsi Jawa Barat). A table of tender items is displayed below, with columns for Kode, Nama Paket, K/L/PD, Tahapan, and HPS.

Kode	Nama Paket	K/L/PD	Tahapan	HPS
65262014	Belanja Modal Pengadaan Perahu Karet Pengadaan Barang - TA 2020 - Tender Cepat - Pascakualifikasi Satu File Harga Terendah Sistem Gugur Nilai Kontrak : Nilai Kontrak belum dibuat	Pemerintah Daerah Provinsi Jawa Barat	Tender Batal	358,8 Jt
65130014	Belanja Modal Pengadaan Sepeda Motor II Pengadaan Barang - TA 2020 - Tender Cepat - Pascakualifikasi Satu File Harga Terendah	Pemerintah Daerah Provinsi Jawa Barat	Tender Sudah Selesai	1,2 M

Figure 1. Tender Homepage
 Source: lpse.jabarprov.go.id

The screenshot shows the details for tender 65130014, 'Belanja Modal Pengadaan Sepeda Motor II'. It includes a table for 'Rencana Umum Pengadaan' with columns for Kode RUP, Nama Paket, and Sumber Dana. Other details include the tender date (27 November 2020), K/L/PD (Pemerintah Daerah Provinsi Jawa Barat), and the value of the tender (Rp. 1.225.650.000,00).

Kode RUP	Nama Paket	Sumber Dana
26680496	Belanja Modal Pengadaan Sepeda Motor II	APBD

Figure 2. Tab 1 Auction Announcement Details
 Source: lpse.jabarprov.go.id

The screenshot shows the 'Peserta' (Participants) tab for the tender. It contains a table with columns for No, Nama Peserta, NPWP, Harga Penawaran, and Harga Terkoreksi.

No	Nama Peserta	NPWP	Harga Penawaran	Harga Terkoreksi
1	PT Tri Wijaya Putri	92.373.941.1-403.000	Rp. 11.538.141.450,00	Rp. 11.538.141.450,00
2	PT. UTAMA KARYA GEMILANG	01.451.175.2-405.000	Rp. 11.657.756.583,00	Rp. 11.657.756.583,00
3	CV. REPIKTRAAPARI	02.761.264.7-421.000		

Figure 3. Tab 2 Tender Participant Details
Source: lpse.jabarprov.go.id

No	Nama Peserta	K	B	A	T	Penawaran	Penawaran Terkoreksi	Hasil Negosiasi	H	P	PK	Alasan
1	PT. UTAMA KARYA GEMILANG - 01.451.175.2-405.000	✓	✓	✓	✓	Rp. 11.657.756.583,00	Rp. 11.657.756.583,00	Rp. 11.633.801.000,00	✓	★	★	
2	PT. DELTA GAMMA UTAMA - 90.900.055.6-404.000	-	-	-	-							
3	CV. REPIKTRAAPARI - 02.761.264.7-421.000	-	-	-	-							

Figure 4. Tab 3 Details of Tender Participant Evaluation
Source: lpse.jabarprov.go.id

Nama Tender	Belanja Jasa Lainnya - Pengadaan Makanan Harian Pasien dan Karyawan			
Jenis Pengadaan	Jasa Lainnya			
KLIPD	Pemerintah Daerah Kota Cirebon			
Satuan Kerja	DINAS KESEHATAN			
Pagu	Rp. 11.734.950.700,00			
HPS	Rp. 11.734.845.294,70			
Nama Pemenang	Alamat	NPWP	Harga Penawaran	Harga Negosiasi
PT. UTAMA KARYA GEMILANG	Jl. Pabuaran No. 12 Rt. 005/002 Kel. Nyomplong Kec. Warudoyong Kota Sukabumi - Sukabumi (Kota) - Jawa Barat	01.451.175.2-405.000	Rp. 11.657.756.583,00	Rp. 11.633.801.000,00

Figure 5. Tab 4 Tender Winner Announcement
Source: lpse.jabarprov.go.id

It is known that some RPA software can process data in multiple other applications. UIPath may retrieve web data, process it in Excel, and store it in a document format, for instance. However, each of these operations requires unique software that UIPath activates. Microsoft Excel is the best option because all these operations can be performed within the software.

The tender start page (Figure 1) can be copied from the web directly into an Excel cell. The remainder of the table is selectable based on delicate code, tender name, and tender stage data. Additionally, the link to the delicate details can be extracted using VBA. By modifying a few phrases, the URLs for each tender information tab can be constructed based on these links. The relevant data is then extracted from the site URL and pasted into a new Excel Sheet, as shown in Figure 6.

	A	D	F
1	Kode	Tahapan	Pengumuman
2	33700014	Tender Sudah Selesai	https://lpse.jabarprov.go.id/eproc4/lelang/33700014/pengumumanlelang
3	33743014	Tender Sudah Selesai	https://lpse.jabarprov.go.id/eproc4/lelang/33743014/pengumumanlelang
4	33747014	Tender Sudah Selesai	https://lpse.jabarprov.go.id/eproc4/lelang/33747014/pengumumanlelang
5	33751014	Tender Sudah Selesai	https://lpse.jabarprov.go.id/eproc4/lelang/33751014/pengumumanlelang
6	33755014	Tender Sudah Selesai	https://lpse.jabarprov.go.id/eproc4/lelang/33755014/pengumumanlelang
7	33756014	Tender Batal	https://lpse.jabarprov.go.id/eproc4/lelang/33756014/pengumumanlelang
8	33757014	Tender Sudah Selesai	https://lpse.jabarprov.go.id/eproc4/lelang/33757014/pengumumanlelang
9	33762014	Tender Sudah Selesai	https://lpse.jabarprov.go.id/eproc4/lelang/33762014/pengumumanlelang
10	33769014	Tender Sudah Selesai	https://lpse.jabarprov.go.id/eproc4/lelang/33769014/pengumumanlelang
11	33777014	Tender Batal	https://lpse.jabarprov.go.id/eproc4/lelang/33777014/pengumumanlelang
12	33781014	Tender Batal	https://lpse.jabarprov.go.id/eproc4/lelang/33781014/pengumumanlelang
13	33784014	Tender Sudah Selesai	https://lpse.jabarprov.go.id/eproc4/lelang/33784014/pengumumanlelang
14	33796014	Tender Sudah Selesai	https://lpse.jabarprov.go.id/eproc4/lelang/33796014/pengumumanlelang

Figure 6. Data Display After Extracted Link

Figure 6 provides a visual representation of a connection that may be found in Tab 1. The association addresses from Tab 1 are copied and pasted into a new column before being used to construct a link to any of the pages in Tabs 2 through 5. In addition, the language in the link shifts based on the tab you are now seeing; for instance, an auction notice transforms into a participant.

The information from the tender start page and the five delicate details tabs will be gathered through web scraping. The data is then restructured and entered an Excel table. The information that was copied was organized in the same manner as the table on the website. Therefore, to execute algebraic operations on the monetary value contained within a cell, some characters must be deleted from the cell. This is necessary for pricing data.

Additionally, depending on the number of times a firm has participated in the tender, the data on the company's tender participants may appear many times. Excel's value reduction technique is repeated to generate a unique participant name. Following this step, the details of the terms and conditions given by the companies taking part in the bid are placed on a new table. After then, each offer will have this table's occurrence scrutinized to determine whether it is there. One can choose the total number of times each year that a firm provides a proposal for another business to consider by using this method. Following an approach comparable to the one employed for the winning data, it is possible to recover both the frequency of company involvement and the winning offer from the two tabs by following the analogous strategy.

Data processing using RPA

This experiment will produce information regarding the disparity between the tender method, the actual field process, and the indicators of suspicious bidders. Discrepancies in the procedure, such as whether there is nontransparent information, such as bidders' identities, are concealed. Another example is a participant appearing multiple times in a tender. These two examples provide helpful information for enhancing the LPSE system. Indicators of suspicious participation can be obtained, for instance, by tallying the number of times a participant has competed in and won the tender.

The retrieved data from the LPSE website must be structured such that the company name appears only once. The method concludes by removing the second occurrence of the firm name, etcetera. The Excel function Remove Duplicates facilitates this approach. This unique company name is then compared to the bidders in each solicitation by marking the bidders. If the marking appears many times in a single bid, then

the corporation participates multiple times in that bid. In addition to mentioning the company's name in the offer, the winner's name is also mentioned. After the data, it is possible to determine the number of times a company participated and won each year.

In addition to data on tender participants, data on the monetary value of the bid can also be processed. Such as the Self-Estimated Price, Ceiling, and the ultimate price agreed upon in the offer. The data extracted from the LPSE website are still text data that cannot be averaged or computed. Among the necessary processing is the removal of the Rp. Character, the comma character and the two digits that follow it, and the thousands separator point. After this processing, the text data must be transformed into numbers before being used to obtain additional information.

Detectable noncompliance with the tender process for the procurement of goods and services

After the data from the RPA process has been produced, the data can be evaluated to deliver relevant information that can be used in audit operations, such as studying RPA-identified irregularities. The analyzed data are described as follows:

a. Performance of Tenders for Procurement of Goods and Service

Table 1. Successful and Unsuccessful Tender Data in 2017-2021

	Jasa Konsultansi Badan Usaha (JKBU)	Pekerjaan Konstruksi (PK)	Pengadaan Barang (PB)	Jasa Lainnya (JL)	Total	JKBU	PK	PB	JL	Total	
2017	Successful	91.255.600.855	1.624.184.351.750	77.920.292.170	57.127.453.307	1.850.487.698.082	83%	58%	73%	61%	60%
	Unsuccessful	18.825.403.120	1.155.191.270.710	28.837.049.966	36.168.492.605	1.239.022.216.401	17%	42%	27%	39%	40%
	Total	110.081.003.975	2.779.375.622.460	106.757.342.136	93.295.945.912	3.089.509.914.483					
2018	Successful	66.029.157.864	1.700.109.614.837	63.238.474.478	86.482.335.793	1.915.859.582.972	84%	93%	73%	86%	91%
	Unsuccessful	12.601.733.095	128.488.366.878	23.405.362.947	14.339.475.524	178.834.938.444	16%	7%	27%	14%	9%
	Total	78.630.890.959	1.828.597.981.715	86.643.837.425	100.821.811.317	2.094.694.521.416					
2019	Successful	121.087.848.023	1.285.241.721.378	223.430.912.848	88.573.575.071	1.718.334.057.320	80%	89%	72%	80%	85%
	Unsuccessful	30.699.299.383	154.844.126.797	87.135.585.495	22.688.850.909	295.367.862.584	20%	11%	28%	20%	15%
	Total	151.787.147.406	1.440.085.848.175	310.566.498.343	111.262.425.980	2.013.701.919.904					
2020	Successful	78.210.282.080	583.254.122.012	102.982.012.362	4.179.120.000	768.625.536.454	56%	30%	67%	35%	34%
	Unsuccessful	62.091.881.895	1.382.400.344.543	51.501.027.702	7.622.336.824	1.503.615.590.964	44%	70%	33%	65%	66%
	Total	140.302.163.975	1.965.654.466.555	154.483.040.064	11.801.456.824	2.272.241.127.418					
2021	Successful	108.537.368.873	1.626.421.289.758	64.497.032.750	20.885.806.369	1.820.341.497.750	75%	78%	72%	66%	78%
	Unsuccessful	36.541.941.495	452.190.268.861	24.865.095.329	10.583.158.086	524.180.463.771	25%	22%	28%	34%	22%
	Total	145.079.310.368	2.078.611.558.619	89.362.128.079	31.468.964.455	2.344.521.961.521					

Table 1 displays the total tender data and the number of successful and unsuccessful tenders. From 2017 through 2021, the performance of the tender implementation can be examined using these data. Considering the length of the term, the governorship changed in 2018. Since 2018, the success rate of the challenging LPSE treatment has grown considerably. 2019 was marked by a drop in almost all categories of procurement. The content of the bid reaches eighty percent. Due to a pandemic in 2020, the number of submitted requests has reduced dramatically. In 2021, however, there is an increase in the number of completed bids.

The data suggest that the ability of the West Java governor and his team to organize and execute tenders is relatively good. Specifically in the sphere of goods procurement, where notwithstanding the pandemic, the composition of the bidders is very stable. However, there is still potential for improvement because the specific trend of the procurement of commodities from year to year shows little or no change. The maximum is limited to 73%.

The budget for construction projects is the largest. The amount exceeds 87% of all funds allocated through bids. The tender's composition is also among the highest yearly, except for 2020. Budget information can also be considered a risk element when selecting a potential audit objective because of the more significant the budget, the greater the potential risk.

b. Detection of potential vulnerabilities in the procurement of goods and services

RPA can be utilized to identify suspected procurement fraud. In his research, Foremny (Anysz et al., 2019) identified four types of colluding behavior, including the number of offers in a single tender, the price range supplied, geographical criteria, and the use of the same set of bids in many tenders. Purwanto (2020) also stated, based on ICW data, the potential for fraud in the procurement of electronic goods and services, including the difference between the estimated price and the value of the auction results, the number of participants, the duration of the auction process, and the number of bidders. According to the criteria for probable fraud established in the initial research, two factors appear in both studies: 1) the number of participants, where a small number of participants or fewer than three can be indicative of possible fraud; 2). The price range is the difference between the auction price and the self-estimated price (HPS).

Based on the criteria mentioned earlier, the data of the companies participating in the tender are analyzed. There was an increase in the average number of participants in one tender. After the pandemic, the growth almost doubled compared to before the pandemic, as shown in Table 2.

Table 2. Number of tender participations in LPSE 2017 – 2021

Year	Detail	Quantity
2017	Number of Tender Participants	41.965
	Number of Tender	816
	Average of Participants for Each Tender	51
	Unique Tender Participant	5.382
2018	Number of Tender Participants	30.268
	Number of Tender	717
	Average of Participants for Each Tender	42
	Unique Tender Participant	4.647
2019	Number of Tender Participants	31.682
	Number of Tender	745
	Average of Participants for Each Tender	43
	Unique Tender Participant	5.067
2020	Number of Tender Participants	23.801
	Number of Tender	300
	Average of Participants for Each Tender	79
	Unique Tender Participant	4.526
2021	Number of Tender Participants	37.132

Year	Detail	Quantity
	Number of Tender	487
	Average of Participants for Each Tender	76
	Unique Tender Participant	5.481

In 2018, there was data collection that did not use the actual name of the tender participant. In some tenders, the company name is disguised as Participant xx. This disguise makes it challenging to verify the number of times the company has participated in and won the tender. Therefore, the company's participation analysis will be conducted for 2019-2021.

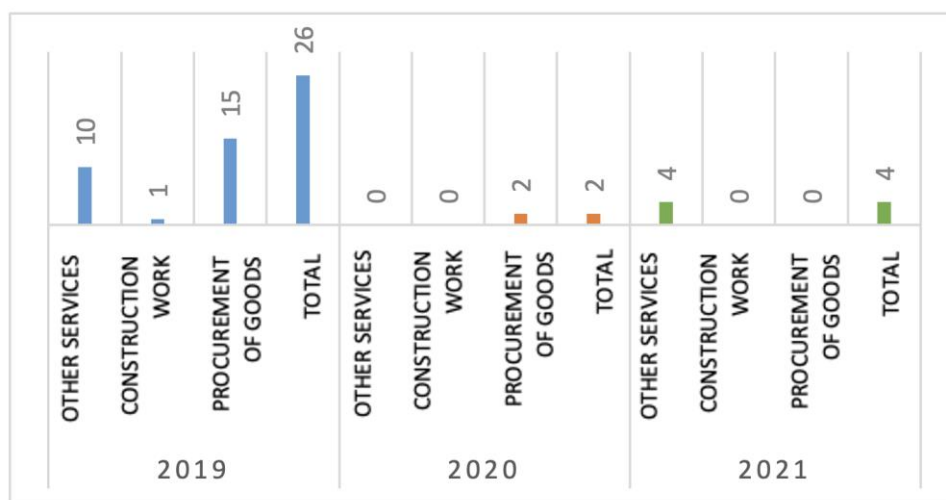


Figure 7. Chart of tenders with less than 3 participants

Figure 7 shows the number of tenders that have less than 3 participants but are declared completed. At the same time, the tender should only be implemented if three or more participants follow it. According to data collected in 2019, 26 tenders with less than or equal to three participants had the opportunity to engage in collusion throughout the procurement process. In 2020 and 2021, this number decreased dramatically.

In addition, the difference between the HPS and the offer price is examined throughout the tender's execution. Based on the results of data analysis from 2017 to 2021, there are tenders completed with a price difference between HPS and the offer price, which is suspicious. Price differences are too far apart until it reaches 1 billion or almost no difference, meaning that the bid price submitted is the same as HPS. The number of tenders with a little price difference is shown in Figure 8 and figure 9.

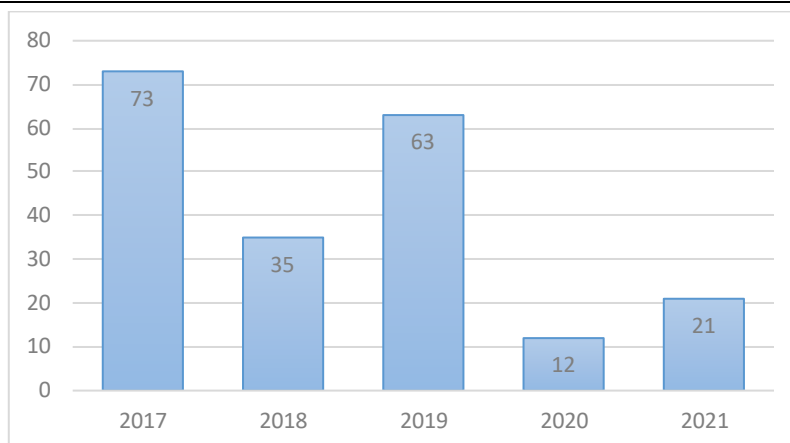


Figure 8. Tender with a slight difference in the bid price with HPS

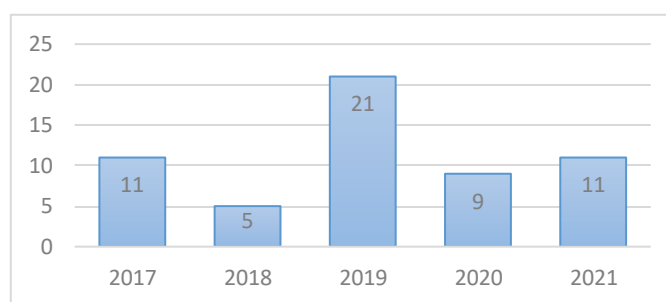


Figure 9. Tender with a significant difference (more than Rp. 1 billion) in the bid price with HPS

According to the preceding diagram, the number of bids with the same bid price and HPS and the number of requests with a price difference with the HPS is excessive and inappropriate. Based on the data, it can also be seen that there is a trend of annual quantity movements where the bid price with the same HPS tends to decrease. However, the offer price with a high difference from the HPS still fluctuates even though the amount is not significant per year.

Inconsistencies in the difference between the HPS and the bid price can indicate fraud or collusion in the tender process for procuring goods and services. They can be used as a critical point in the audit's implementation so that it can be included in the primary audit objective. The emergence of an offer with a modest and huge price differential compared to HPS may be due to a pseudo-competitor whose primary aim is to win over other companies that have cooperated and will provide a lower price. The same price offer with HPS can occur if a specific firm is appointed. However, because the tender process must be passed first, the tender process is merely a formality in which the winning company presents a price offer identical to HPS to assure victory.

Discussions

We employ a spreadsheet (Microsoft Excel) to automate actions that the computer in the conducted research can do. Among the activities performed are extracting LPSE data and storing it in Excel, removing unnecessary data elements, and processing the data using descriptive statistics.

Although Microsoft Excel with Visual Basic for Applications is only acknowledged as a lower-level macro than RPA, it turns out that process automation can be accomplished effectively. Obtaining descriptive statistical data affords the possibility of conducting the subsequent auditing procedure.

For example, data on the appearance of companies in one year of tender can be known, the number of wins, and the number of arrivals in one year of tender. This information can be used to improve the LPSE system so that the tender process can take place more efficiently, for example, through the initial selection process for companies that meet the requirements.

Several essential data were recovered effectively from the LPSE of West Java Province. West Java Provincial Government officials and auditors have immediate access to these data. The data in LPSE is challenging to summarize for other shareholders, such as tender participants or the public, who want to participate in monitoring the tender process.

For example, how often a company participates in tenders, how often it submits an offering in one tender, and how many times it wins is not easy to read from the data available on the web. With the RPA, such data will be easily obtained by stakeholders who do not have administrative access to the LPSE server.

In the case of the West Java Province LPSE, it was discovered that several companies engaged in the bidding process over one hundred times. There are even some businesses that observe more than 300 tender submissions each year. Although no restriction prohibits a corporation from participating in delicate hundreds of times, this circumstance represents a waste of auditing resources.

The LPSE system should be used to do the first screening for these conditions. Because each type of tender is different, it has its own rules. There are four types of buying goods and services for companies that already know what they need. These include small businesses, construction companies, service companies, etcetera. Suppose some companies take part in hundreds of tenders in one year. Likely, they do not meet the requirements for several tenders. The goal of the LPSE system is to make the tender process run smoothly so that the company's needs can be checked from the start and an audit doesn't have to be carried out later.

Moreover, based on observations of West Java LPSE data processing results in specific years, some businesses appear multiple times in the same tender. This demonstrates that the LPSE system has not performed efficiently to guarantee that the tender is conducted under regulations. The system should be able to recognize multiple instances of the same company in a single tender. In a more complex setting, the system should be able to detect the presence of a cartel, i.e., numerous companies working together to assure a successful bid for the group. Even if the company's name is different, it may have the same owner if registered in the exact location or a certain distance from other areas.

From the information in LPSE, you can't directly find out where the company is. You can do more research about this address on the Ministry of Law and Human Rights or another company's website. This job must be done by other parts of the RPA, especially now that artificial intelligence is being used to help location-based company classification.

CONCLUSION

Based on research, this is what we know about RPA's ability to extract data, process data to make meaningful information and find differences in goods and services. Essentially any data can be accessed as needed from the LPSE portal using RPA. In a public sector procurement audit, the number of tenders performed annually, the number of successful and unsuccessful tenders, which fields commonly fail, the percentage of failures, the number of tenders in which the company participated, and the number of victories can be gathered and utilized. Data retrieval/extraction from the LPSE online using RPA involves numerous phases, including web scraping (kind of tender data, status of delicate stages, list of businesses participating in tenders, list of tender winners), data cleansing data processing, and data synthesis/visualization. All these steps can be accomplished with Microsoft Excel as RPA. After extracting the data from the LPSE web, it is necessary that the company name only appears once. The Excel Duplicate Elimination function assists in this process of eliminating duplicate company names. In addition to calculating the value of money in the tender, the data is converted into numbers and can obtain further information. Eliminating data duplication and converting text into numbers can be done well using RPA. RPA can detect indications of noncompliance in the tender process for the procurement of goods and services, including the detection of irregularities in the procurement of goods, such as the number of failed tenders, the presence of tender participants who participated in the auction more than one hundred times, and the irregularity between the bid price and the HPS. Using RPA, it is feasible to spot abnormalities in the tender process; however, there are restrictions, including the fact that the location of the company cannot be obtained instantly from LPSE data and requires access to the company's website. For further research, RPA with Excel can be paired with artificial intelligence, such as in a corporation that collects data by location. According to another source, one of the symptoms of fraud in tenders is grouping enterprises from the same place to compete in tenders. LPSE also provides non-tender data, which is more numerous than tender data. There may be hidden information that could be of interest to the audit because of its direct appointment, which is more vulnerable to fraud. With the same technique and the application of artificial intelligence, it is hoped that auditors can help reduce fraud in budget spending.

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