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Data Analysis for Corruption Indications on Procurement of Goods and Services

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***Abstract*—Corruption occurs in many developing countries and is very difficult to detect because of weak legal awareness, lack of good governance, and integrity. In Indonesia, there are seven types of corruption cases handled by the Corruption Eradication Commission (KPK). One of the corruption cases which is detrimental to the state occurs in public procurement, such as the procurement of goods/services. This case is the second most corrupt crime after bribery in Indonesia. In this research, we try to identify potential corruption from auction data on goods/services procurement in government. By using Big Data technology, it is expected that the process can be carried out immediately to assist the KPK in identifying potential corruption in goods/services procurement auctions.**

Keywords—Corruption, Big Data, Machine Learning

I. INTRODUCTION

Corruption is the most challenging fraud to detect because it is not done individually but involves other parties who work together. In developing countries, this type of fraud often occurs. This problem might be due to weak law enforcement and lack of awareness of the application of good governance so that the integrity of services both individuals and corporations is still questionable. Corruption often cannot be detected because those who work together enjoy their benefits (mutual symbiosis). Statistics from the Corruption Eradication Commission (KPK), based on the type of case, it is divided into seven types of corruption cases [1], as seen in Figure 1. Corruption related to the procurement of goods/services ranks second most after a bribery case. Even though the procurement process, complaints, and reporting mechanism in Indonesia are quite reasonable based on the Bank Word 2016 benchmark report, and Indonesia has implemented electronic procurement [2]. Based on the Association of Certified Fraud Examiners (ACFE) report in 2018 for the Asia-Pacific region, government and public administration sectors are the third-highest numbers after the manufacturing and financial sectors (banking and financial services) [3].

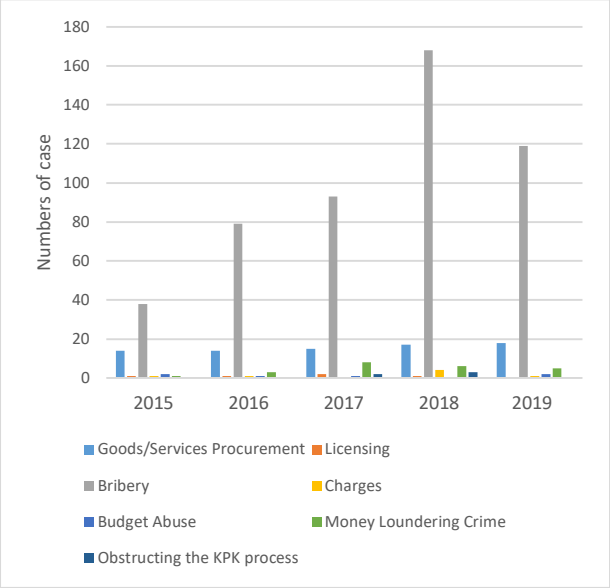

Fig. 1. Statistics based on the type of case [1]

Analytics with bigdata environment and technology allow researchers to develop prediction models with minimum data, and that becomes more accurate over time. Almost all disciplines can be analyzed with big data. This research analyses data on the procurement of goods/services to identify indications of fraud and corruption. The results of this research are to facilitate the performance of anti-corruption agencies in determining projects that are indicated to be misused and corrupt.

II. RELATED WORKS

S. N. Huda *et al.* try to find potential fraudulent in Indonesia e-procurement systems and then categorize and analyze their findings [4]. The fraud is categorized into two: insider frauds and outsider attacks. Outsider attacks mostly because of the infrastructure readiness of the e-procurement system. Further related to the contracting process and internal control, J. Rendon and R. Rendon found that majority fraud because of some of the government and the contractor collusion scheme and the contractor. Most frequent frauds are bribery and markup value, and majority fraud happened during the source selection and contract administration phases on their research at the US Department of Defense (DoD) [5]. Individuals with high pressure and high opportunity are more vulnerable to the fraud triangle (pressure, opportunity, and rationalization) [6].

A. Dhurandhar. et al. proposing a big data architecture and infrastructure to analyze the risky potential procurement data [7]. Their result is a fully worked design of a big data environment for prospective risk assessment. Big data helps increase the effectiveness of several procurement processes in supporting decision making [8]. Big data technology combining with machine learning Naïve Bayes approach can achieve 97% accuracy of prediction in the medical data approach [9]. It is a promising method to implement in the procurement to analyze the process and predict the corruption. In terms of procurement audits, Big data can provide valuable information in government procurement auditing [10]. With the Extract, Transform, and Load (ETL) framework on top of Big data infrastructure, it can provide data in near real-time [11]. Data visualization is also essential for the client to quickly understand the data. J. Zhang. et al. studied and developed visual analytics using parallel coordinate visualization techniques based on their previous model of 5Ws bigdata dimension [12]. Their result makes a clearer and better understanding of data. A big data environment can also be used in the geographical location of the data center for parallel computation [13]. The computational performance is being benchmarked and monitored with satisfactory results [14]. Besides, big data technology can also be implemented as an information center with data lake technology [15]. This configuration provides advantages in computing processes and even standardization of data access.

In this study, the data will be displayed with indications of corruption. The use of big data technology in this research is to eliminate the computational obstacle while processing the data.

III. Proposed Method

The author describes the process flow and methods used in this study in Figure 2 below.

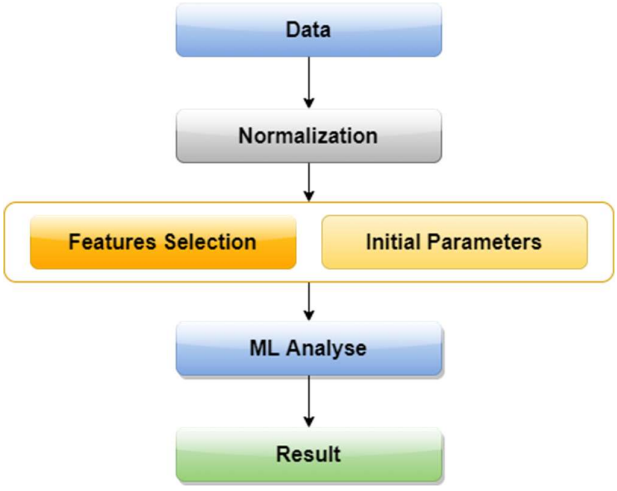

Fig. 2. Proposed method

A. Data Set

The data set is the 2017-2018 procurement/goods procurement auction data provided by the Government Goods and Services Procurement Policy Agency (LKPP), the Corruption Eradication Commission (KPK), and the Indonesian Corruption Watch (ICW) [16].

B. Indications

Based on the Indonesia Corruption Watch (ICW), variables that can be used as an indication to determine the potential for corruption from goods/services procurement auctions:

1) The Difference in Estimated Own Price (HPS) with the value of the auction results.

If the efficiency of the value of the auction results with HPS is close together, then the potential for corruption is high. Conversely, if the efficiency is far away, the potential for corruption is small.

2) The Number of Participants

To ensure the principle of fair competition and auctions are not considered to omit, the number of participants who pass verification is a minimum of three [17]: the fewer participants, the higher the potential for corruption.

3) The length of the auction process

The duration of the auction process that is too fast or too long is very vulnerable to corruption.

4) The Number of Participants who made the bid

A large number of participants must also be followed by bidding. If only a few participants bid, it is feared that there will be a game where the number of participants will only meet the minimum quota.

IV. Result and Discussion

Normalization data is performed to be able to start the data analysis. This normalization process includes equating values based on data types, for example, for the numerical field that is filled with the minus (-) or null characters, eliminating the outliers and also unnatural data.

A. The Difference in Estimated Own Price (HPS) with the value of the auction results

To find out how close the value of HPS and auction results, the first proportion comparison between the two is performed. Then use the Interquartile Range (IQR) to eliminate outliers from the distribution of relative data proportions to the value of HPS and auction results. A description of the proportion comparison data after the IQR process can be seen in Table I.

TABLE I. Proportion Data Describe

Property	Value
count	108838.000000
mean	0.046114
std	0.048410
min	-0.094741
25%	0.010560
50%	0.026438
75%	0.065570
max	0.197595

Based on Table I, the authors chose quartile 25 data as an indication of the value of HPS that is too close to the auction results. We then group the data based on the province and descend the order from the highest indication to the low and show in graphical charts.

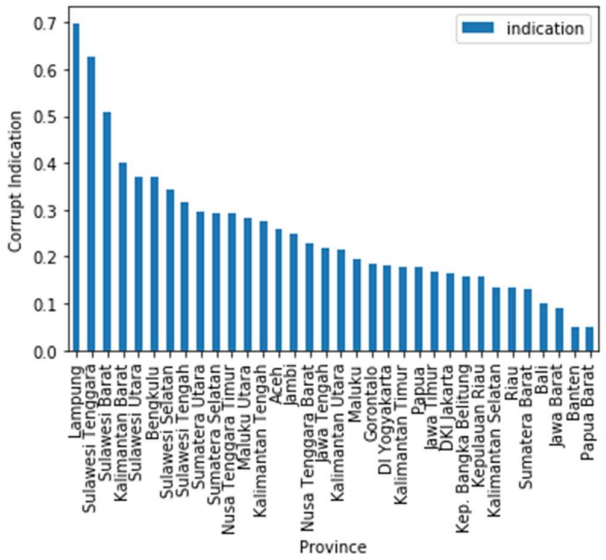

Fig. 3. Corruption proportion based on estimated own price

Figure 3 above is provincial data with a proportion of corruption indication based on the comparison of HPS and auction results. The proportion value is obtained by counting the number of projects in a province indicated by corruption divided by the number of projects in that province.

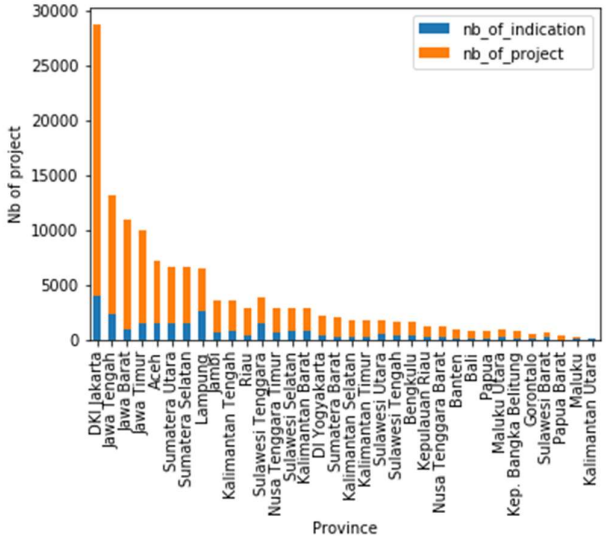

Fig. 4. Numbers of indication project vs. Numbers of project

Figure 4 above shows the information on the number of projects that indicated corruption compared to the number of projects in each province sorted by many projects descending.

B. *The Number of Participants*

Based on the number of participants, the data used is the number of participants below 3, referring to the rules related to the bidders, the auction technically does not meet these rules. To obtain this data, what needs to be performed is to filter using the parameter number of participants.

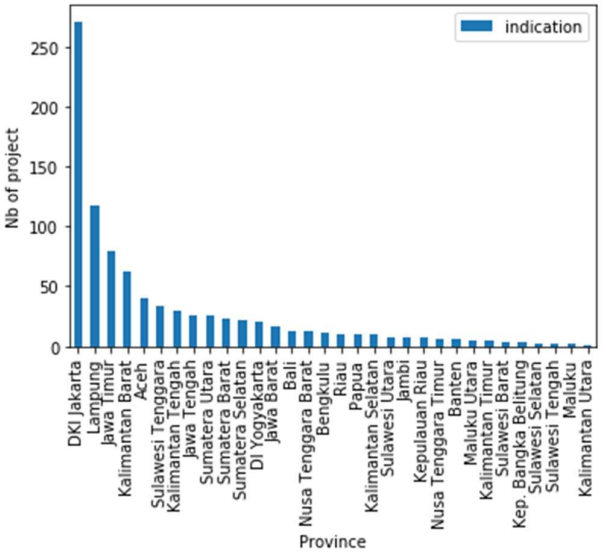

Fig. 5. Indication based on the numbers of participants

Figure 5 above shows the information on the number of projects that indicated corruption seen from the number of participants who did not meet the minimum rules in each province.

C. *The length of the auction process*

The length of time the auction process is calculated in units of days from the date of the auction announcement to the auction end date. Data distribution is obtained as in Table II.

TABLE II. AUCTION LENGTH DATA DESCRIBE

Property	Value
count	114764.000000
mean	23.565935
std	36.287369
min	1.000000
25%	14.000000
50%	19.000000
75%	28.000000
max	2162.000000

Based on the data in Table II, and to indicate the auction process that is too fast and too long, the writer chooses quartile 25 and quartile 75.

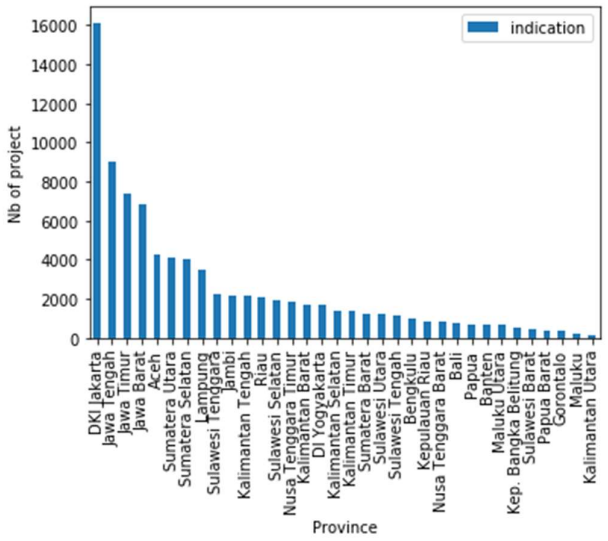

Fig. 6. Indication based on the length of the auction

Figure 6 above shows the number of projects that indicated corruption seen from the length of the auction time that is too fast or too long in each province.

D. The number of participants who made the bid

The number of participants who bid at the time of the auction follows the minimum rules of participants participating in the auction. In this approach, the authors use the composition of 20% of participants who participate in the auction must make an offer. If it is lacking, then the related project is indicated to be corruption.

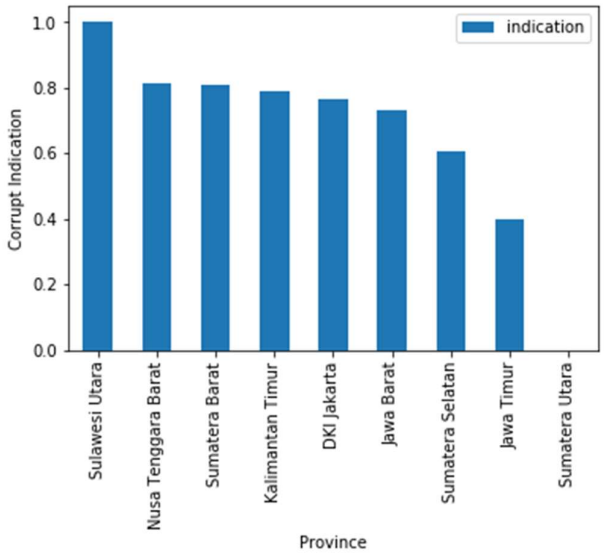

Fig. 7. Corruption proportion based on numbers of the bidder

Figure 7 above is provincial data with an indication of corruption based on a comparison between the number of participants and the number of bidders bidding. The indication value is obtained by counting the number of projects in the province that indicated corruption divided by the number of projects in that province.

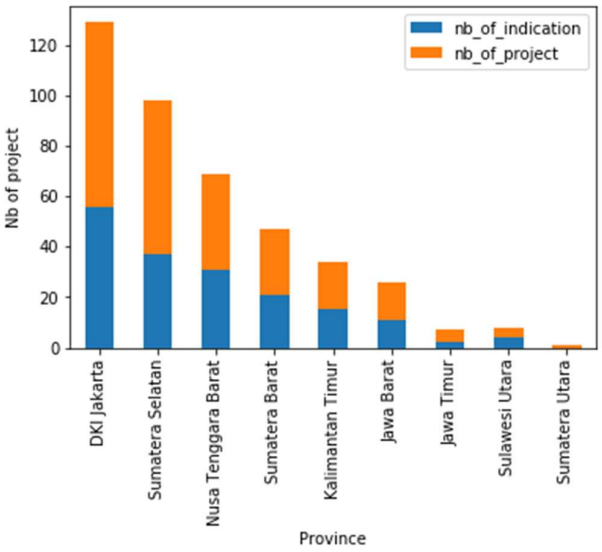

Fig. 8. Numbers of indication project vs. Numbers of project

Figure 8 above is a project data that is indicated as corruption because it does not meet a minimum of 20% of bidders bidding. The number of indicated projects is compared with the number of projects that meet the bidders' standards in each province.

Based on the estimated own price, Lampung province has the most significant indication of corruption in the procurement of goods and services, with an indication of 69.89%, indicating that as many as 2663 out of 3810 total projects in the province. The following result is Sulawesi Tenggara with 62.73% (1490 of 2395), Sulawesi Barat with 50.97% (236 of 463), Kalimantan Barat with 40.21% (828 of 2059), and Sulawesi Utara with 37.00% (484 of 1308).

Based on the number of participants who did not comply with the minimum participant rules, in the DKI Jakarta province, there were 271 projects—followed by Lampung with 118 projects, Jawa Timur with 80 projects, Kalimantan Barat with 63 projects, and Aceh with 40 projects. DKI Jakarta Province also has 16143 projects, which are indicated by the auction process conditions that are too fast or too long. Then followed by the provinces of Jawa Tengah, Jawa Timur, Jawa Barat, and Aceh with an indication respectively of 8998, 7408, 6797, and 4298 projects.

Based on data analysis, from a total of 4 projects that met the minimum criteria for bidders in North Sulawesi province, all of them did not have an adequate number of bidders bidding. Followed by the provinces of Nusa Tenggara Barat 81.57%, West Sumatra 80.76%, Kalimantan Timur 78.94%, and DKI Jakarta 76.71%.

V. Conclusion

This analysis aims to identify the potential for corruption in the procurement of goods and services in government. This is very important considering corruption is one of the biggest problems in Indonesia and in the world. Based on the criteria used by the author to analyze the data, it can be concluded that several projects for the procurement of goods and services in Indonesia have indicated corruption.

In the future, with the opening of auction data disclosure, it is hoped that an analysis of corruption indications can be

carried out more quickly, even before the project runs and can help the government reduce corruption.

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