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A study of university procurement performance based on big data on government procurement

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Abstract: *The scale of government purchases in colleges and universities has been growing as a result of the elevated importance China has given to education. Investments in scientific research and education have also expanded dramatically. Most universities currently pay little attention to performance evaluation in government procurement work, do not fully complete government procurement performance evaluation work, or are still in the mapping stage of government procurement performance evaluation. As a result, the performance evaluation index is comparatively small. In this paper, we establish a government procurement performance evaluation system for universities in combination with big data on government procurement, and we put forward recommendations for universities to further improve the performance management of government procurement. We do this by analyzing the current situation of government procurement in contemporary universities and the shortcomings in the performance evaluation work of S colleges and universities.*

Keywords: *University government procurement; Big data; Performance*

1. Introduction

The 20th Party Congress suggested that "education, science, and technology, as well as talents, are the basic and strategic support for the comprehensive construction of a modern socialist country," and that "the strategy of developing the country through science and education, and strengthening the support of talents for modernization." If financial resources are not used effectively and the results are ineffective, universities' capacity for teaching, research, and development — and even China's educational advancement—will undoubtedly suffer.

The amount of money the state invests in colleges has grown yearly, and so has the scope of government procurement. In this scenario, the risks that will be encountered throughout the government procurement process are gradually growing, and if no appropriate risk prevention and management techniques are adopted, it may also damage the stable and harmonious development of society [1].In addition to optimizing the procurement management activities of colleges and universities through the feedback of performance results, the implementation of performance management of government procurement in colleges and universities can, on the one hand, effectively identify problems and risks in all aspects of procurement and solve, prevent, and control them promptly. On the other hand, it can raise the government's credibility, which will boost the public's contentment.

In 2015, the State Council released the Action Plan for Promoting the Development of Big Data, which had three key objectives. To support the steady and harmonious growth of the economy and society, government agencies at all levels were required to first promote the application of big data technology, then use it to support local economic development and transformation, and finally, use it to carry out security enhancements.

These days, thanks to the quick growth of big data, cloud computing, and other information technology, it has permeated all spheres of society and played a crucial role in bolstering the framework of government information management and enhancing government management functions. The procurement activities of universities have been significantly innovated and developed as a result of using big data, cloud computing, and other information technologies in the current context of "national decentralization, management, and service", as opposed to the traditional simple statistical analysis of data[2]. This has good effects on the implementation of procurement performance evaluation at universities since it allows for a more accurate, efficient, and scientific evaluation of the efficacy and efficiency of procurement activities.

ISSN 2616-5902 Vol. 5, Issue 4: 77-86, DOI: 10.25236/AJBM.2023.050413

2. The connotation of big data in government procurement

All data that is gathered and processed during government procurement activities are collected as "government procurement data." Government procurement data is vast and extensive, and it can be categorized into the following: government procurement budget database, government procurement project database, government procurement supervision database, government procurement agency database, government procurement supplier information database, government procurement evaluation expert management database, government procurement relief database, and government procurement program database.

The main government procurement data that the procurer should gather are, in general, the following: procurement project funds budget data, procurement project funds implementation data, procurement project savings rate, savings, supplier inquiry data, supplier challenge data, supplier consultation resolution data, supplier response or reply satisfaction data, data on information disclosure, pre-procurement project feasibility assessment report, and post-implementation performance evaluation. Please do not add any headers, footers and page numbers in the article, as we will do that uniformly.

3. The current situation of government procurement in China's universities

3.1. Overview of government procurement in China's universities

The government procurement system has been implemented in universities, which has both sped up the development of universities themselves as well as standardized and improved the general management level of universities. University procurement is a crucial component of government procurement. On the other hand, universities only recently started using government procurement. The procurement departments of universities need to improve their knowledge of the government procurement system to adapt to the development trends of the society and the economy, innovate and develop China's education, and fulfill the demands of high-level development of our institutions.

To enhance the professional ability of university procurement staff and to optimize the management of government procurement in universities, the Ministry of Education created a government procurement training course in 2016. Each institution has developed a pertinent procurement management system based on its unique situation and steadily improved it in practice with the improvement of China's system of rules and regulations relating to government procurement.

The proportion of national financial education expenditure to national financial expenditure from 2016 to 2020 is 14.95%, 14.86%, 14.56%, 14.57%, and 14.80%, respectively, as shown in Table 1 below. Statistics show that national education expenditure, national financial education expenditure, and national financial education expenditure are all rising annually.

Table1: Statistics on our education spending from 2016 to 2020

	2016	2017	2018	2019	2020
National education spending (RMB million)	388,883,850.00	425,620,069.00	461,429,980.00	501,781,166.00	530,338,700.00
State financial resources for education (RMB million)	313,962,519.00	342,077,546.00	369,957,704.00	400,465,452.00	429,081,500.00
State financial expenditure on education (RMB million)	280,728,000.00	301,531,800.00	321,694,700.00	347,969,400.00	363,599,400.00
State financial expenditure (RMB million)	1,877,552,100.00	2,030,854,900.00	2,209,041,300.00	2,388,583,700.00	2,456,790,300.00
State financial expenditure on education as a proportion of state financial expenditure	14.95%	14.85%	14.56%	14.57%	14.80%

Data source: National Statistical Office

According to Figure 1, from 2016 to 2020, both the national education spending and the national financial education expenditure exhibit a consistent, significant growth trend. Government procurement funds play a significant role in the structure of how financial resources are used in universities, and the

ISSN 2616-5902 Vol. 5, Issue 4: 77-86, DOI: 10.25236/AJBM.2023.050413

efficiency with which these funds are used will directly impact the growth of China's educational system, the efficiency of national financial spending, the legitimacy of the government, and the public's satisfaction with the country's educational system. The majority of universities have established government procurement departments, and while they strictly adhere to the applicable laws and regulations of China when conducting their business, they have also established their procurement management systems and regulations following their unique circumstances and requirements. However, the majority of universities have not built a systematic and thorough system for evaluating performance in government procurement work, and they have only superficially examined the outcomes of this work without including performance evaluation in the entire process.

Therefore, it is important to focus on ways to increase the effectiveness of university government procurement and the performance evaluation system for university procurement.

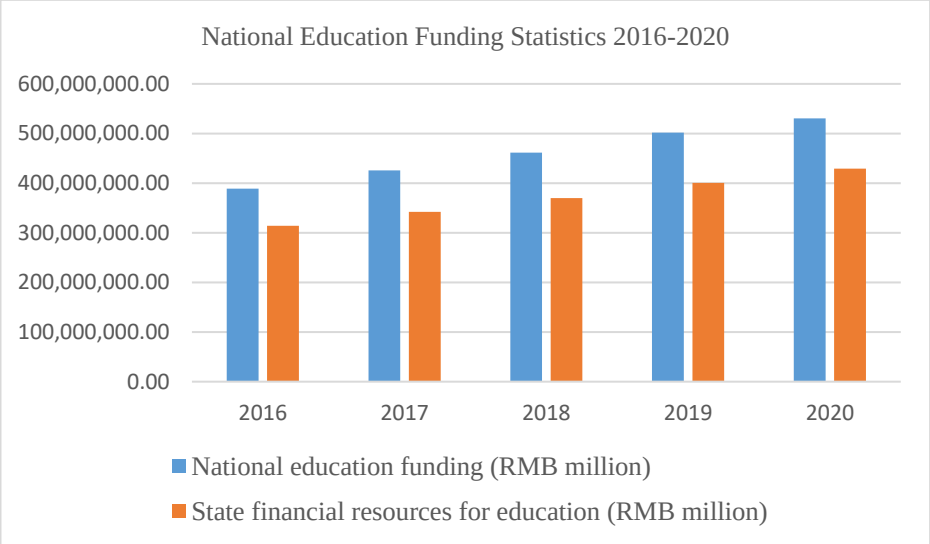

Figure 1: National education funding statistics 2016-2020

3.2. Characteristics of government procurement in China's universities

3.2.1. Complexity and diversity of university procurement

Given that the purpose of modern universities is to foster the development of specialized skills, scientific knowledge, and societal service, universities are much larger and more complex than general administrative organizations, and what needs to be purchased is not only general infrastructure, products, and services, etc., but also teaching equipment, scientific research equipment, and materials, professional software, etc., which are needed for teaching and research activities.

3.2.2. High demand for university procurement

China has been actively advancing education and boosting investment in the sector, while the size of universities has been growing in recent years, all under the impact of the development plan of "building the country through science and education."

3.2.3. Time-sensitive and poorly planned university procurement

Because universities receive funding from a variety of sources, it can be challenging to predict when and how much money will be allocated for things like research funding. In addition, universities have complex internal organizations, with many departments and secondary colleges having independent funding. It is challenging to achieve an appropriate allocation of resources for instruments and equipment since some high-tech information equipment or goods are updated quickly and the procurement strategy is frequently outdated before it is executed. A thorough, timely, and accurate instrument and equipment procurement plan is therefore extremely difficult to adopt and complete. When funds are available, departments or colleges frequently ask for timely purchases without enough planning, which makes it difficult to meet their time requirements if the purchases are made following the government procurement system and processes.

ISSN 2616-5902 Vol. 5, Issue 4: 77-86, DOI: 10.25236/AJBM.2023.050413

3.2.4. Low accuracy of procurement budgeting in universities

The major component of the government procurement plan and a crucial foundation for carrying out government procurement operations is budgeting. However, a significant issue in universities is the poor precision of budgeting for public procurement. Some universities don't establish a unique and perfect expert evaluation system and expert evaluation database, and the procurement budget is not properly managed as a result. On the one hand, the majority of universities are unaware of the significance and role of government procurement budgeting, and frequently don't conduct enough specific market research. On the other side, some institutions do not yet have a unique and faultless expert evaluation method or database, making it challenging to develop a procurement budget that is both scientific and precise. Additionally, as was already mentioned, many departments or second-level colleges in universities have the autonomy to use funds and have different requirements, making it challenging to take into account all departments' and units' requirements when preparing the procurement budget. As a result, the accuracy of government procurement budgeting may decline to some extent.

4. Government procurement and performance in S University

4.1. Introduction to S University

With nine fields, including engineering, science, management, education, literature, history, art, law, and economics, the university is a full-time institution with approximately 60 years of undergraduate study and nearly 20 years of postgraduate education. There are 17 provincial first-class majors, nine national first-class undergraduate majors, four national featured majors, nine provincial featured majors, five national majors under the Excellence in Engineer Education and Training Program, four provincial applied model majors, and three national engineering practice education centers. One provincial post-doctoral innovation practice base, three national engineering practice education centers, one national off-campus practice education base for university students, four national teaching demonstration centers, four national virtual simulation experimental teaching centers, and one provincial experimental zone for innovation of talent training mode; 15 province "Curriculum Thinking and Government" Model Courses, 10 Provincial Model Applied Courses, 1 National First-Class Course, 22 Provincial First-Class Courses The university offers 10 applied demonstration courses at the provincial level, one national first-class course, 22 first-class courses at the provincial level, 15 "curriculum thinking and government" demonstration courses at the provincial level, and six demonstration courses at the provincial level for innovation and entrepreneurship education. Postgraduate, undergraduate, and international students together make up about 45,000 of the total enrollment.

4.2. Statistics on government procurement expenditure of university S in the past three years

According to government procurement data of S University, 67 products totaling ¥21,161,500 were purchased by the government in 2019. The total amount of government procurement in 2021 increased by ¥14,303,500 and ¥5,179,400, respectively, compared to the previous two years, and the number of items purchased increased by 21 items and 12 items, though both decreased in 2022. By 2021, the amount of procurement and the number of items in S University were on the rise.

Of them, as stated in Table 2 below, all of the government procurement expenditures of S University are mostly for capital expenditures such as the purchase of research and teaching equipment and building renovations.

Table2: Government procurement statistics for S University 2019-2022

Information on government procurement projects in S University				
	2019	2020	2021	2022
Goods category (RMB million)	1,642.49	2,585.22	2,901.09	1,406.79
Services (RMB million)	277.32	420.84	521.21	794.62
Engineering (RMB million)	241.35	67.50	169.21	237.50
Total (RMB million)	2,161.15	3,073.56	3,591.51	2,438.90
Number of items purchased	67	76	88	66

Data source: Chinese government procurement website

As we all know, one of the three roles of universities in scientific research, and the quantity of outcomes from that research also reflects the caliber of that research and the academic standing of universities. To analyze the performance of their government procurement in terms of the transformation

ISSN 2616-5902 Vol. 5, Issue 4: 77-86, DOI: 10.25236/AJBM.2023.050413

proceeds of S universities' scientific research achievements, this study counts the scientific and technical transformation results of S universities from 2019 to 2022.

As shown in Table 3, the amount and quantity of science and technology transferred from S universities increase annually from 2019 to 2021 before declining by 2022.

Figure 2 also shows a concurrent increase and decrease in the amount of government procurement spending and the amount of scientific and technological advancements made in S University. This indicates that the amount of government procurement spending in universities has some influence on the number of scientific research advancements. It is clear that to maximize their effectiveness, universities must effectively supervise government procurement funds, conduct performance evaluations, and apply feedback on performance results. This has some positive implications for raising the caliber of universities' scientific research.

Additionally, as depicted in Figure 3, the ratio of scientific and technological advancements in S University has grown more and is on an upward trend, which also suggests that the government procurement projects in S University have had a good impact.

Table 3: Statistics on the results of science and technology transformation in S University 2019-2022

Transformation of scientific and technological achievements in S University				
	2019	2020	2021	2022
Amount (RMB million)	25.10	82.20	435.70	349.88
Number of results	15	23	71	37

Data source: S University's official website

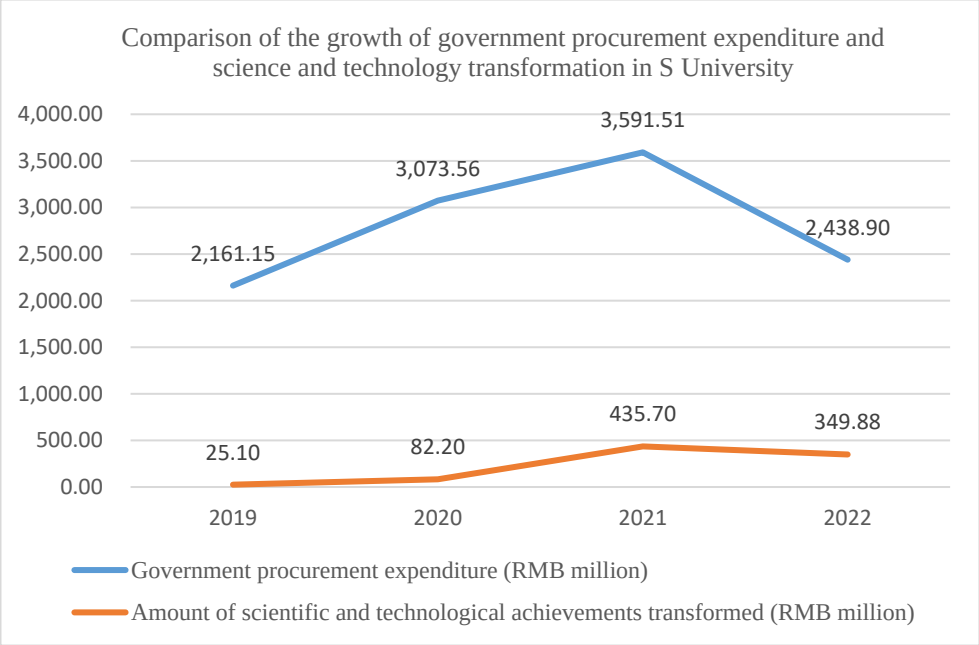

Figure 2: Comparison of government procurement expenditure and growth in science and technology transformation in S University

ISSN 2616-5902 Vol. 5, Issue 4: 77-86, DOI: 10.25236/AJBM.2023.050413

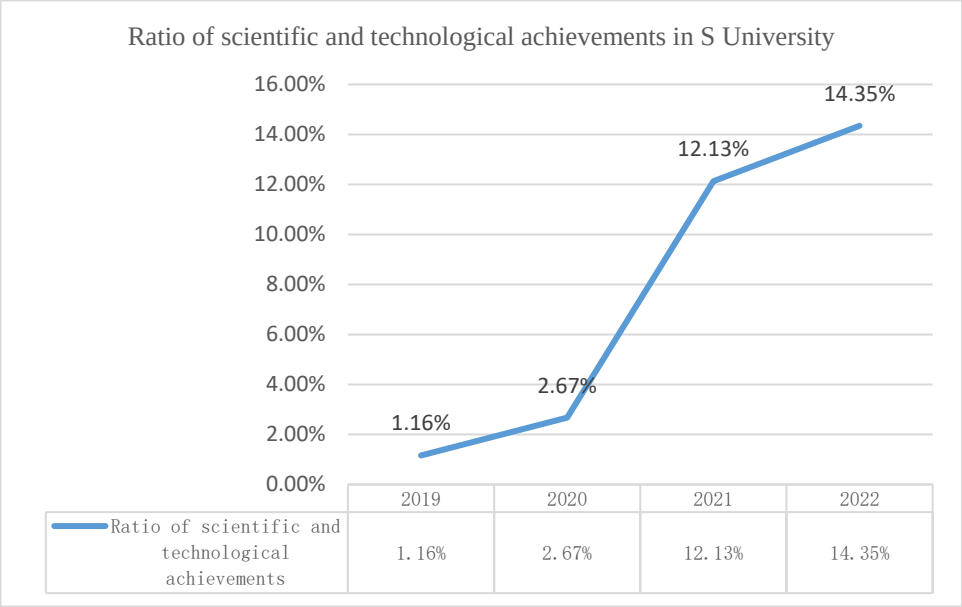

Figure 3: Growth in the ratio of science and technology conversion in S University

Universities may therefore decide to use the indication of the transformation of their research results when assessing the performance of government procurement. However, universities should not just focus on this item when evaluating the performance of their government procurement; they should also take other aspects into account, such as the coverage of student benefits, the labor cost of the procurement process, the procurement cost-benefit ratio, etc.

4.3. Problems in the performance management of government procurement in S universities

In this paper, the following problems are found in the performance management of government procurement in S University.

4.3.1. No specific procurement performance management system in place

S University is no different from other Chinese universities in that their procurement management departments only currently report departmental overviews, rules and systems, and transaction data; they do not, however, evaluate the performance of specific major purchases or unique projects, nor do they have a dedicated system for tracking procurement performance.

4.3.2. Insufficient emphasis on conducting procurement performance work

For instance, just two projects—the creation of "book purchase funds" and "experimental and practical training rooms"—have undergone self-evaluation in 2020. For instance, when implementing 76 government procurement projects in 2020, S University only carried out self-evaluation for two projects, namely "building of laboratory and training rooms" and "book purchase." Additionally, no thorough performance evaluation of the year's worth of government procurement initiatives was carried out. Additionally, as of the end of 2022, only the performance self-evaluation of two procurement projects in 2020 was made available on the official website of S University.

4.3.3. Performance evaluation indicators are not comprehensive enough

As mentioned above, the government procurement of universities is characterized by complex and diversified contents, large demands, strong timeliness of procurement, poor planning, and low accuracy of procurement budgeting, etc., while the indicators of procurement performance evaluation in S universities are almost all for post-facto performance, and the first-level indicators are mainly the three categories of project completion indicators, benefit indicators, and satisfaction indicators, and there is no performance evaluation on the budgeting and execution of government procurement, timely fund There is no performance evaluation on budget preparation and execution, timely payment of funds, completion time, labor cost and suppliers' complaints, and insufficient attention is paid to the ex-ante and ex-post control of government procurement work.

The majority of universities of the same caliber as S institutions do not place a high value on assessing

ISSN 2616-5902 Vol. 5, Issue 4: 77-86, DOI: 10.25236/AJBM.2023.050413

the effectiveness of government procurement, and some information connected to government procurement is only partially and very late given, according to this study's findings. Therefore, both S and other universities need to set up a procurement performance evaluation system to efficiently oversee government procurement funds, prevent misuse and waste of funds, and maximize the benefits of procurement funds, to not only improve the management level and governance ability of universities, but also to promote the healthy development of universities, so that they can fully play the three functions of scientific research, talent transfer, and education.

5. Building a university procurement performance evaluation index system based on government procurement big data

5.1. Principles for establishing a university procurement performance evaluation system

5.1.1. Combining qualitative and quantitative

To more fully and accurately reflect the information about the evaluated object, the evaluation of university procurement performance should combine subjective and objective evaluation, not only concentrating on quantitative indicators but also taking into full account non-quantitative indicators.

5.1.2. Applicability

To ensure the applicability of the procurement performance index system, the establishment of the university procurement performance evaluation system should not only fully reflect the concept of science, innovation, and development, but also take into account the factors of the social environment and combine them with laws and regulations. The system should also be fully designed with the actual situation of our government procurement work and management in mind[3].

5.1.3. Feasibility

To increase the applicability of the overall performance indicator system, it is essential to avoid selecting evaluation indicators that are difficult to use when choosing indicators for universities' procurement performance.

5.1.4. Focusedness

To highlight the focus of procurement performance evaluation indicators and ensure that they are accurate, universities should combine their procurement systems, regulations, and procedures with actual procurement activities. They should also reflect these aspects fully and specifically, rather than merely listing the indicators, and should divide the importance of all evaluation indicators.

5.2. Determining procurement performance evaluation indicators

The renowned management scientist Peter Drucker once observed, "If you can't evaluate, you can't manage." To make sure that the university procurement performance evaluation system functions, performance evaluation indicators for university procurement must be established.

The management level, objectives, and degree of system perfection of each university vary due to the influence of regional policies, resources, levels of teaching and research, development strategies, and other factors. As a result, the content of the evaluation of the procurement performance of universities varies as well, but there are a few differences in the procedures used to determine the indicators. They all often comprise the following steps: Analysis of relevant positions and clarification of staff rights and responsibilities; Analysis of the characteristics of the elements of performance and determination of their nature - qualitative or quantitative; Comparison of the evaluation indicators with the performance evaluation objectives and principles; Further improvement of the system related to government procurement in universities; Clarification of the system related to government procurement in universities.

The majority of the currently employed techniques for evaluating the performance of the procurement process are based on the balanced scorecard, along with other techniques like hierarchical analysis and DuPont analysis. So, to ensure a relevant and reasonable choice when determining the index, the university government procurement performance evaluation index system in this paper is also based on the aforementioned theoretical methods. It also combines the content of government procurement big data with the characteristics of university government procurement.

ISSN 2616-5902 Vol. 5, Issue 4: 77-86, DOI: 10.25236/AJBM.2023.050413

Table 4 displays the government procurement performance evaluation index methodology for institutes of higher education.

Table 4: Government procurement performance evaluation index system for higher education institutions

	Tier 1 indicators	Secondary indicators	Tertiary indicators	Characteristic
Performance targets for government procurement projects in higher education	Financial Indicators	Funding	Procurement budgeting rate	Quantitative
			Procurement budget execution rate	Quantitative
			Procurement size growth rate	Quantitative
			Procurement budget savings rate	Quantitative
			The yield on procurement costs	Quantitative
			Total procurement surplus	Quantitative
		Manpower	Procurement costs per capita	Quantitative
			Training costs per procurement staff	Quantitative
	Efficiency indicators	Time-sensitive	The time frame for completion	Quantitative
			Timeliness of payment of funds	Qualitative
			Average procurement lead time	Quantitative
		Administrative aspects	Procurement waste rate	Quantitative
		Personnel	Competence of procurement staff	Qualitative
			Professional ethics for procurement staff	Qualitative
	Satisfaction indicators	For suppliers	Supplier complaint rate	Quantitative
			Supplier satisfaction	Qualitative
		For users	User complaint rate	Quantitative
			User satisfaction	Qualitative
	Business Management Indicators	Institutional management	The extent to which procurement regulations are sound	Qualitative
			The extent to which the procurement regulatory system is well developed	Qualitative
		System implementation	Procurement non-compliance rate	Quantitative
			Procurement change rate	Quantitative
			Public tender rate	Quantitative
			Public transparency	Quantitative
	Benefit indicators	Scientific research results	The ratio of scientific and technological achievements	Quantitative
		Talent Development	Student Benefit Coverage	Quantitative
		Social	Domestic production rate of goods procured by the government	Quantitative

In this essay, we argue that government procurement projects should establish indicator weights based on various project categories, and then design further assignments based on the management traits, goals, and levels of development of individual universities, as well as institutional or departmental settings. However, it should be noted that universities should also seek out or consult with experts to ensure the reasonableness of the assigned values and enhance the scientific nature of the procurement performance evaluation system after determining the values of the procurement performance evaluation indicators. Questionnaires can be used to gather opinions in addition to consulting experts, but caution should be exercised in their construction to increase the density of the questionnaires and the values given to the indicators. Teachers and students of relevant majors in universities can also construct and assign indicators for procurement performance evaluation since they have more talent than other groups and are more familiar with the management level and system of universities.

Additionally, the aforementioned metrics are graded on a scale of 100 points, and judges should assign

ISSN 2616-5902 Vol. 5, Issue 4: 77-86, DOI: 10.25236/AJBM.2023.050413

them points based on the university's actual condition. They range from 0 to 60, with 60 to 70 being ordinary, 70 to 80, 80 to 90, and 90 to 100 representing superb. After scoring, the results should next be averaged and weighted following the assignments and weights given to the actual condition of colleges and universities.

6. Suggestions for universities to further improve procurement performance management

Building a thorough, reasonable, and scientific university procurement performance management system is necessary for universities to achieve scientific and efficient performance management and improve the integration of budget and performance management. However, universities also need to enhance the performance management operation mechanism.

6.1. Raising the profile of procurement performance evaluation in universities

Enhance communication and exchange with university-level administrators, pertinent departments, and staff to emphasize the value of implementing government procurement performance evaluation work[4]. On the other hand, hold more training sessions or meetings on performance evaluation work to enhance the professional competence and caliber of pertinent staff and encourage the smooth implementation of procurement performance evaluation, thereby increasing the efficacy of the process.

6.2. Making the most of information technology

Big data technology has been extensively incorporated into government agency systems, as was already indicated, and numerous institutions have now developed procurement platforms. To encourage more reasonable, accurate, and effective university procurement performance evaluation, universities should fully integrate their performance evaluation systems with their procurement platforms through information technology and embed performance evaluation indicators into procurement contract management, supplier management, bidding agent management, and other sub-sections.

6.3. Adhere to the principles of fairness, impartiality, and openness

Universities should uphold the values of fairness, impartiality, and openness in both performance evaluation and procurement activities[5]. They should also improve system management and process oversight. To maximize the effectiveness of financial funds and enhance the operational efficiency of the entity, universities should establish an open and transparent university procurement performance evaluation system, emphasize the significance of the problems encountered in the performance evaluation process, provide prompt feedback and solutions, as well as conduct analysis and summaries to make up for the deficiencies or defects therein and optimize the management system.

6.4. Strengthening the application of performance evaluation results

Universities can organize a specialized working group for performance evaluation to enhance the procurement performance management system, ensure effective performance evaluation implementation, and implement evaluation results. University staff, students, and even the general public can all gain a thorough understanding of the content and procedures of government procurement activities, as well as offer their opinions or suggestions, by utilizing the existing government procurement information technology to realize the disclosure of performance evaluation information about government procurement activities. This will not only increase the efficiency and effectiveness of government procurement management in universities, but it will also strengthen the evaluation process for university procurement performance. Universities should also improve how performance evaluation results from procurement projects are applied, and they can do this by setting up a system of rewards and penalties that is appropriate and serves as an incentive to ensure that performance evaluation results are effectively applied to the activities of subsequent procurement projects.

7. Conclusion

In short, the university administration is inextricably linked to the execution of procurement performance. Universities' procurement departments need to update the way they think about purchasing and place more emphasis on performance evaluation. They also need to use information technology to

ISSN 2616-5902 Vol. 5, Issue 4: 77-86, DOI: 10.25236/AJBM.2023.050413

gather data on all types of procurement risk while developing an index system that is reasonable, realistic, scientific, and efficient for performance evaluation. Big data can effectively avoid and control pertinent hazards in addition to increasing the effectiveness of university procurement management and performance evaluation through the use of big data technologies in conjunction with government procurement. This can significantly raise the overall management standard of universities and ensure their long-term, sustainable growth.

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