



# Application of K-Means Cluster Analysis for Grouping State Islamic University in Indonesia based on the Readiness Indicators for World Class University (WCU)

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## ABSTRACT

Based on Moscow Ranking 2021, State Islamic University in Indonesia is still lower than other non-Islamic State University. This shows that the mapping of higher education readiness is an important aspect in preparation for WCU. Thus, there is a need for more in-depth research related to the level of readiness of universities. This study aims to determine the data description of the readiness of State Islamic Religious Colleges (PTKIN) to World Class University (WCU) and classify them based on that readiness. Quantitative methods are used in this study. The data were analyzed by K-Means Clustering. The data used in this research obtained from the Ministry of Religion's e-SMS Diktis system. The e-SMS system is a collection of data in each unit at a university based on WCU indicators, namely Good Governance University (GUG), University's Performance Improvement (UPI), Competitive Advantages University (CAU), and Global Recognition University (GRU). The results of the analysis show that from the four indicators it has not been able to achieve 100%. In addition, there are three clusters produced, namely PTKIN is very ready, ready, and not ready to go to World Class University (WCU). PTKIN need hard work in each indicator to be an international standard.

**Keywords:** Clustering; K-Means; World Class University; e-SMS

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## INTRODUCTION

For many years, there have been discussions about World Class University (WCU) [1]. Universities of the highest caliber are what colleges in various nations aim to become [2]–[5]. Universities that fit the WCU categorization must be realized, which requires money, time [6], and strategy [7]. Supporting infrastructure and educational facilities is expensive. This needs to be prepared over a sufficient amount of time. Universities also need an institutional strategy to accomplish their objectives. Global rankings are something that universities all over the world aspire to. The Times Higher Education Supplement (THES), The Academic Ranking of World Universities (ARWU), and Webometrics are three organizations that currently list the greatest universities in the world [5], [8]. The ranking results of each institution may differ because the indicators used are also different [8].

According to the Moscow Ranking 2021, seven campuses in Indonesia are currently ranked among the best in the world. These include Airlangga University, UGM, ITB, UI, and Padjadjaran University. In the meantime, five State Islamic Universities (PTKIN)—namely, UIN Sunan Gunung Djati Bandung (ranked 36th), UIN Syarif Hidayatullah (ranked 47th), UIN Sunan Ampel Surabaya (ranked 64th), UIN Raden Intan Lampung (ranked 72nd), and IAIN Kendari (ranked 73rd)—are among the top 100 universities in Indonesia according to Webometric Rank [9]. According to the rankings, it is known that PTKIN still trails a number of state universities overall.

PTKIN needs to have the correct plan in place to get ready for the WCU. The criteria utilized by a number of organizations, such as The Times Higher Education Supplement (THES), the Academic Ranking of World Universities (ARWU), and Webometrics, can be used to analyze this technique. The following are some of PTKIN's strategies for WCU: 1) improving the quantity and quality of published research results; 2) providing quality teaching services that are responsive to stakeholder needs; 3) developing a website; 4) demonstrating leadership; 5) implementing sound university governance; 6) fostering relationships and collaboration with other institutions; 7) expanding PTKIN's global presence; and 8) establishing a campus culture at PTKIN [10].

Universities need to identify their strengths and skills as one of their WCU strategies because there are so many requirements for WCU preparation. Universities require this capability mapping in order to develop future plans and strengthen some areas that still need work. This demonstrates that mapping higher education readiness is a crucial component of WCU preparation. Therefore, there has to be more in-depth research on the preparation for higher education. Grouping these universities according to how prepared they are to transfer to WCU is one strategy that can be used.

Cluster analysis, particularly when utilizing the K-Means clustering algorithm, is one of the most widely utilized grouping techniques in research [11]–[13]. It aims to partition the entire dataset into roughly equal groups, with the similarity of records within one group having the highest value and that of records inside another group having the lowest value [14]. In accordance with this, K-Means is a non-hierarchical data grouping technique that divides existing data into one or more clusters or groups, with data belonging to the same cluster grouping together data with similar characteristics, and data belonging to separate groups grouping together data with different qualities [12]. K-Means grouping is used in a variety of debates, including those about trading, agriculture, and other topics.

According to the number of scientific publications, universities can be divided into three groups using the cluster analysis method: PTN BH (Perguruan Tinggi Negeri Badan Hukum, or PTN BH), PTN non-BH, and PTN BH [15]. In this study, the High Education Religion Islam (HERI) development stage plan was utilized to assess PTKIN's readiness based on WCU indicators created by the Directorate of Islamic Higher Education of the Ministry of Religious Affairs of the Republic of Indonesia. The development strategy created by the Directorate of Islamic Higher Education has four phases [16]. The first phase focuses on capacity building and governance of PTKIN (Good Governance University (GUG)). The second phase focuses on building HERI's excellence at the national level (University's Performance Improvement (UPI)). The third phase focuses on building regional competitiveness (Competitive Advantages University (CAU)). The fourth stage is a reference for world Islamic universities (Global Recognition University (GRU)).

The Directorate of Islamic Higher Education created the electronic Strategic Management System, or e-SMS, to track each stage of PTKIN's progress in relation to GUG, UPI, CAU, and GRU [16]. The numerous indicators of international rating agencies are used

to create the indicators used in e-SMS. The internal quality assurance system, the function of the internal audit unit, standard operating procedures, performance-based budgeting, the leader-lecturer ratio, the management information system, student organizations, organizational behavior, and the internalization of Islamic values are among the indicators measured at the GUG stage. Scientific advancement, human resource performance, unit contribution, study time duration, average value, institutional level of accreditation, study program accreditation value, and graduate competitiveness are among the variables tracked at the UPI stage. Research quality, institute and community service, international indexed journals, nationally accredited journals, international publications, foreign students, and financial sustainability are indicators measured at the CAU stage. The last stage, Gru are measured indicators such as international cooperation, ratio of foreign lecturers, international award winner, and global socioeconomic impact.

The Electronic Higher Education Strategic Management System will integrate clustered PTKIN, particularly those having PTKIN status, in 2021 [9]. There are 24 PTKIN clusters, including: UIN Alauddin, UIN Antasari, UIN Ar-Raniry, UIN Datokarama Palu, UIN Fatmawati Sukarno Bengkulu, UIN Imam Bonjol, UIN Kiai Haji Achmad Siddiq Jember, UIN Mataram, UIN Maulana Malik Ibrahim, UIN Professor Kiai Haji Saifuddin Zuhri Purwokerto, UIN Raden Fatah, UIN Raden Intan, UIN Raden Mas Said Surakarta, UIN Sayyid Ali Rahmatullah Tulungagung, UIN Sultan Aji Muhammad Idris Samarinda, UIN Sultan Maulana Hasanuddin, UIN Sultan Syarif Kasim Riau, UIN Sulthan Thaha Saifuddin , UIN North Sumatra, UIN Sunan Ampel, UIN Sunan Gunung Djati, UIN Sunan Kalijaga, UIN Syarif Hidayatullah, and UIN Walisongo. In order to evaluate universities' readiness for their transformation into WCU, study was done. This study uses the Electronic Strategic Management System, or e-SMS, of the Ministry of Religious Affairs of the Republic of Indonesia to categorize PTKIN in Indonesia according to indicators of readiness for WCU.

## **METHODS**

The Ministry of Religion's e-SMS Directorate of Islamic Higher Education system provided the data used in this study. The information is a compilation of information based on the indicators GUG, UPI, CAU, and GRU from each department within the university. The data used is from 2021, and 24 PTKIN were included in the study. The K-Means clustering approach was then used to examine the data in the subsequent steps;;

1. Determining Cluster Analysis Variables
2. Choosing a Cluster Analysis Design
3. Assumptions of Cluster Analysis
4. Cluster Formation

- a. Calculating Euclidian distance:

$$d = \sqrt{\sum_{i=1}^N \sum_{j=1}^J \sum_{l=1}^K (X_{ij} - C_{ij})^2}$$

- b. Determine the members of each cluster by using the results of the calculation of the closest distance.
- c. Calculating the centroid of each cluster:

$$C_{ij} = \frac{1}{n_{ij}} \left( \sum_{i=1}^{N_{ij}} X_{ij} \right)$$

- d. Repeating the process a to c until the data is saturated, meaning that there is no

change in members in each cluster

Information:

- $K$  : many clusters
- $X_{ij}$  : variable used in clustering
- $C_{ij}$  : centroid in the cluster
- $i$  : index of the amount of data used
- $j$  : index of the number of variables used
- $l$  : index number of centroid

5. Cluster Interpretation

6. Cluster validation and profiling

Based on the exposure related to the WCU indicators in introduction, the clustering variables that will be used in this study include:

X1 : GUG stage achievement indicator

X2 : UPI stage achievement indicator

X3 : CAU stage achievement indicator

X4 : GRU stage achievement indicator

Based on the four main variables, it was developed into several sub-variables

## RESULTS AND DISCUSSION

### GUG Indicator Achievement

The implementation of a professional leadership system and the creation of an internal quality assurance system in compliance with the National Higher Education Standards (NHES) are the two sub-indicators that make up the GUG indicator. Data on indicators for the actualization of a professional leadership system are displayed in Figure 1.



Figure 1. PTIKIN's achievement on the sub-indicators of the realization of a professional leadership system

If Figure 1 were ranked, PTKIN would be UIN Sultan Syarif Kasim Riau, UIN North Sumatra, and UIN Imam Bonjol, which have the lowest average percentage. Meanwhile, UIN Syarif Hidayatullah, UIN Sunan Gunung Djati, and UIN Sunan Ampel have the highest average percentages.

The development of an internal higher education quality assurance system in conformity with the NHES is the second sub-indicator on the GUG indicator. Figure 2 displays the success of the indicators for the creation of an internal quality assurance system for higher education in accordance with the NHES.

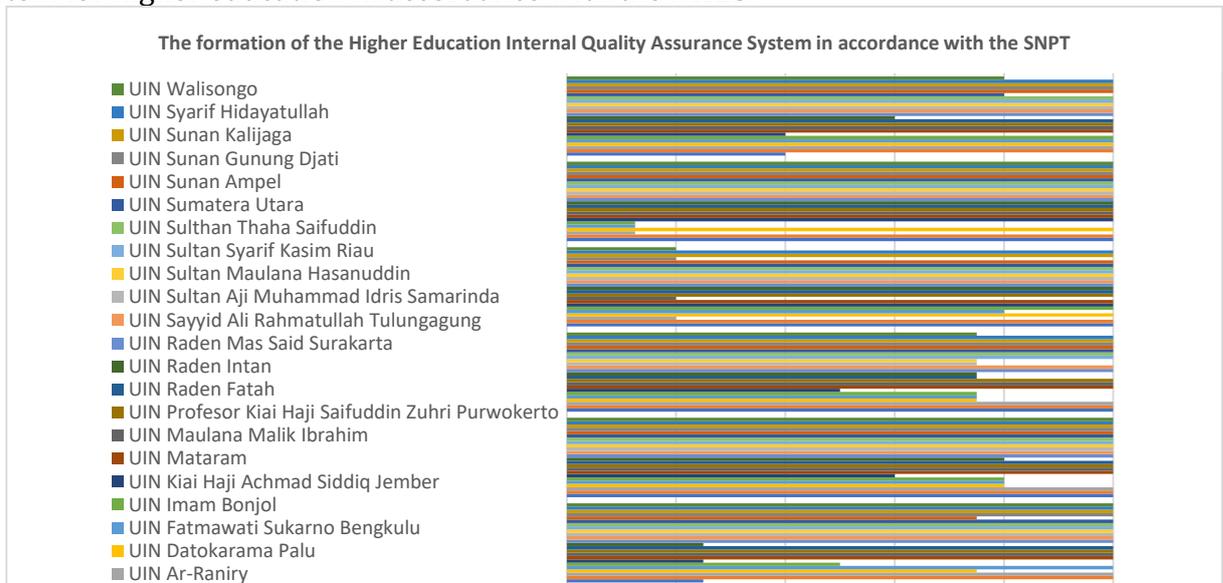


Figure 2. Achievement of PTKIN in the sub-indicators of the formation of the Higher Education Internal Quality Assurance System in accordance with the NHES

PTKIN, which has the lowest average percentage among the sub-indicators in Figure 2, is followed by UIN Ar-Raniry, UIN Kiai Haji Achmad Siddiq Jember, and UIN Fatmawati Sukarno Bengkulu. UIN Antasari, UIN Mataram, UIN Professor Kiai Haji Saifuddin Zuhri Purwokerto, UIN Raden Mas Said Surakarta, UIN Sayyid Ali Rahmatullah Tulungagung, UIN Sultan Syarif Kasim Riau, UIN Sultan Thaha Saifuddin, UIN Sunan Kalijaga, and UIN Syarif Hidayatullah are among those with the highest percentage. The overall view of PTKIN that satisfies the GUG indication is depicted in Figure 3.

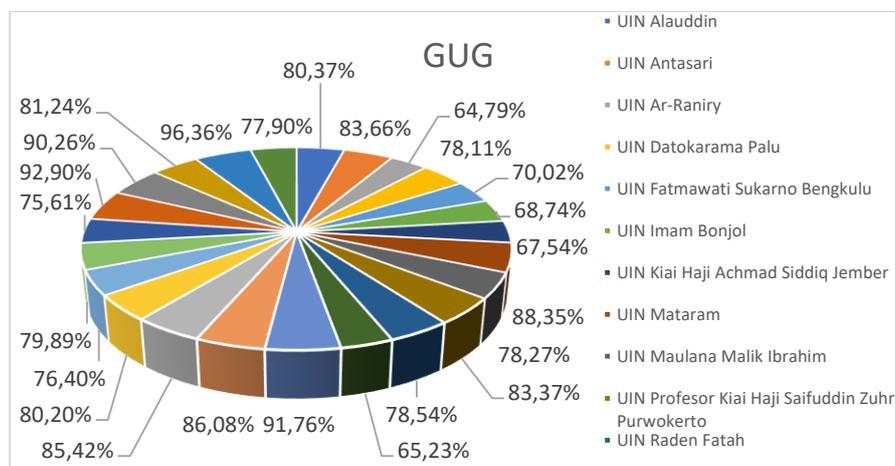


Figure 3. Achievement of PTKIN on the GUG indicator

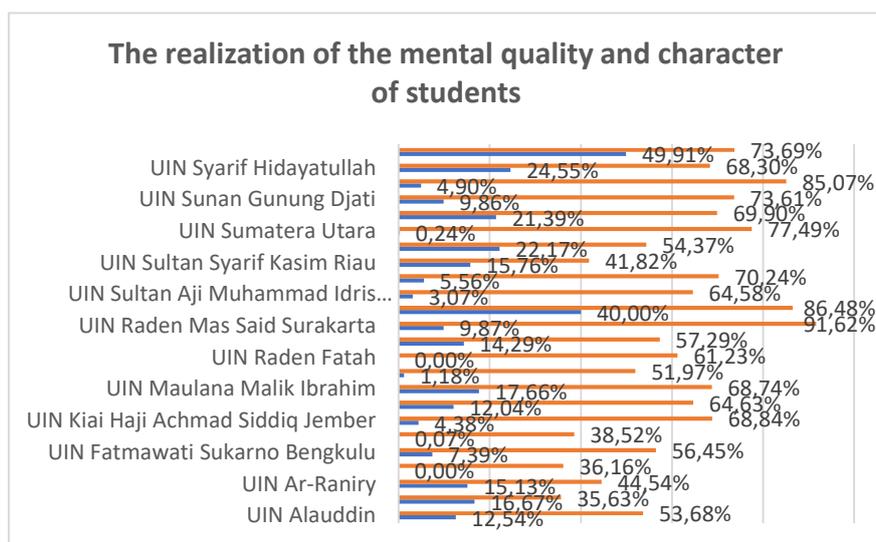
Looking at Figure 3's overall GUG indication, we can deduce that the PTKINs UIN Ar Raniry, UIN Kiai Haji Achmad Siddiq Jember, and UIN Imam Bonjol have the lowest average proportion. UIN Syarif Hidayatullah, UIN Sunan Gunung Djati, UIN Sunan Ampel, and UIN Raden Mas Said Surakarta have the highest average percentages, meanwhile.

GUG at PTKIN internalizes Islamic principles in its implementation. This distinguishes PTKIN from other universities. Superior-quality human resources are required to administer effective university governance by modeling and putting into practice the virtues of Prophet Muhammad SAW, specifically Siddiq (true), Amanah (trustworthy), Fatonah (intellectual), and Tabligh (informing one another) [17]. If university administration can demonstrate these four prophetic traits, academic quality will be strong and they will be able to effectively implement GUG principles.

Transparency, accountability, responsibility, independence, fairness, quality assurance, relevance, effectiveness, efficiency, and non-profit must all be adhered to in the implementation of GUG [17]–[21]. GUG assists universities in effectively achieving their mission and vision and producing high-quality educational output [22]. Internal control, often known as quality assurance, is crucial to the accomplishment of GUG's goals. The accomplishment of GUG is positively impacted by the work of the internal control unit [23]. However, the GUG achievement at PTKIN has not actually been maximized. The use of GUG concepts has not been fully and satisfactorily optimized institutional management [24]. This is evident from the lack of transparency in budget planning, management, and execution; the continued sufficiency of accountability; the continued weakness of responsibility; and the underutilization of independence space [24].

### UPI Indicator Achievement

The first UPI indicator has two sub-indicators: the first is the realization of students' mental quality and character, and the second is the strengthening of the educational system from a moderate perspective. The initial sub-indicator has two components. Figure 4 demonstrates how students' mental attributes and character compare to others.

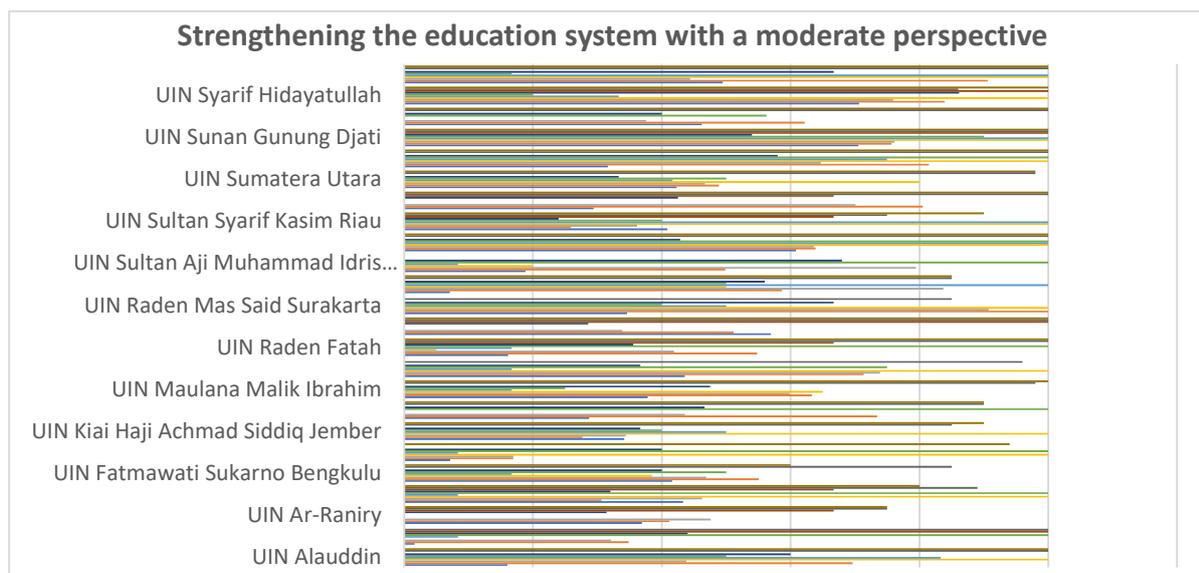


**Figure 4.** Achievement of PTKIN on the indicators of the realization of the mental quality and character of students

According to Figure 4, PTKIN contains UIN Antasari, UIN Datokarama Palu, and UIN Imam Bonjol, which according to the National Accreditation Board for Higher Education

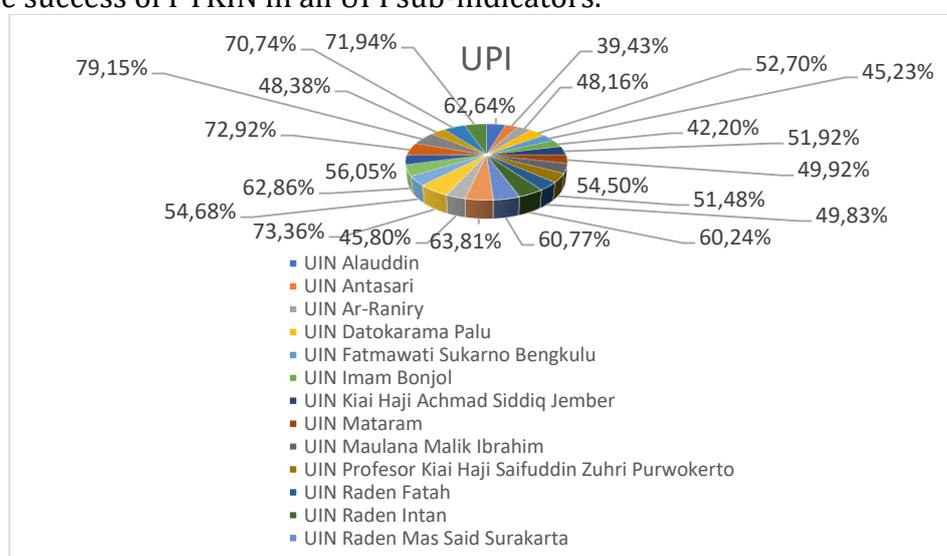
has the lowest proportion of on-time graduation in each study program. PTKIN with the highest percentages include, among others, UIN Sayyid Ali Rahmatullah Tulungagung, UIN Raden Mas Said Surakarta, and UIN Sunan Kalijaga. UIN Datokarama Palu, UIN Raden Fatah, and UIN Imam Bonjol are all part of PTKIN, which has the lowest percentage on the sub-indicator of the availability of student exchange programs. And UIN Walisongo, UIN Sayyid Ali Rahmatullah Tulungagung, and UIN Syarif Hidayatullah had the greatest percentages of PTKIN.

The improvement of the educational system, with a moderate viewpoint made up of 10 factors, is the subject of the second UPI indicator. Figure 5 provides information on the improvement of the educational system from a moderate viewpoint.



**Figure 5.** PTKIN's achievement on indicators of strengthening the education system with a moderate perspective

The PTKINs with the highest percentages are UIN Sunan Gunung Djati, UIN Sultan Maulana Hasanuddin, UIN Sunan Ampel, and UIN Syarif Hidayatullah, according to the average percentage of the 10 sub-indicators. Meanwhile, UIN Antasari, UIN Imam Bonjol, and UIN Fatmawati Sukarno Bengkulu had the lowest average percentages. Figure 6 shows the success of PTKIN in all UPI sub-indicators.



**Figure 6.** Achievement of PTKIN on UPI indicators

Figure 6 shows that UIN Antasari, UIN Imam Bonjol, and UIN Fatmawati Sukarno Bengkulu are all part of PTKIN, which has the lowest average percentage of UPI indicators. Meanwhile, UIN Sunan Gunung Djati, UIN Sultan Maulana Hasanuddin, and UIN Sunan Ampel are included in PTKIN, which has the greatest average proportion of UPI indicators.

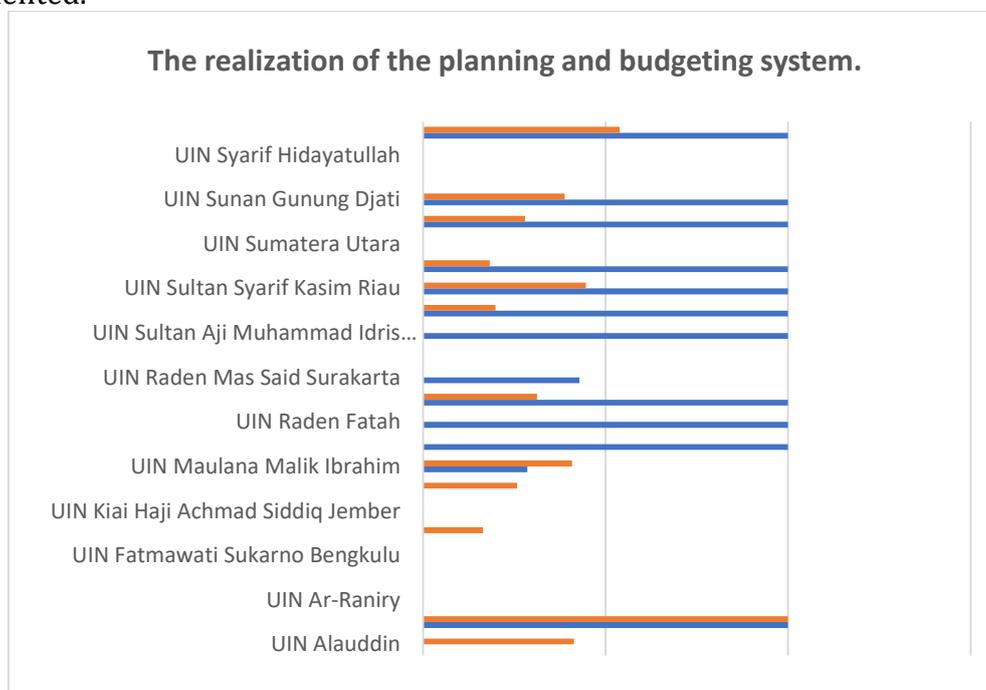
UIN Sunan Gunung Djati achieved the greatest overall UPI sub-indicator achievement percentage, at 79.15%. Then came UIN Sunan Ampel and UIN Sultan Maulana Hasanudin. There is currently no PTKIN that is 100%. A well-implemented GUG will be beneficial in many ways, including the standard of instruction, accessibility of facilities, and happiness of students [25]. So that students are happy with the services offered by educators and education professionals, effective teaching needs to be backed by adequate facilities.

The ability of students to succeed academically also depends on their cognitive requirements. If the instruction given to students in higher education satisfies their cognitive needs, these needs can be satisfied [26]. Universities must hire qualified academics and provide a positive learning environment in order to deliver quality instruction and generate the best graduates [27].

Because academic and social policies in higher education differ from those of the government, changes in some areas of higher education have an effect on changes in other closely linked areas [28]. As a result, stakeholders practice social responsibility and work hard to build a solid reputation for excellence [27]. This makes it appropriate for universities to adhere to current government regulations, one of which is the Ministry of Religious Affairs' directive to apply religious moderation in educational activities.

### **CAU Indicator Achievement**

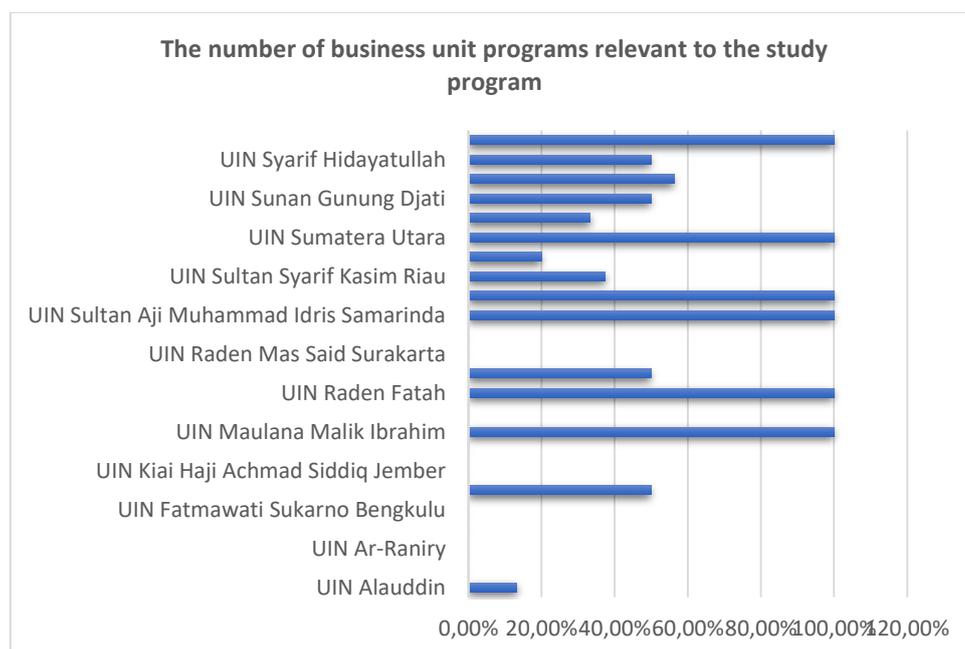
The implementation of a planning and budgeting system, as well as improving funding and the efficiency of education budget use, are the two sub-indicators that make up the CAU indicator. Figure 7 depicts the planning and budgeting system as it has been implemented.



**Figure 7.** PTKIN's achievement on the sub-indicators of the realization of the planning and budgeting system

The realization of the planning and budgeting system's sub-indicators is depicted in Figure 7 as being successful. Institutions of higher learning regularly review and follow up on how the budget is being implemented, and they have budget information broken down by funding source. These sub-indicators led to the conclusion that UIN Sunan Gunung Djati, UIN Raden Intan, and UIN Antasari had the greatest average percentage scores for PTKIN.

The number of business unit programs that are pertinent to the study program can be used to gauge the sub-indicator of the efficacy of the usage of the education budget. The number of business unit programs that are pertinent to the study program can be used to gauge the sub-indicator of the efficacy of the usage of the education budget. The quantity of business unit programs pertinent to the study program is depicted in Figure 8.



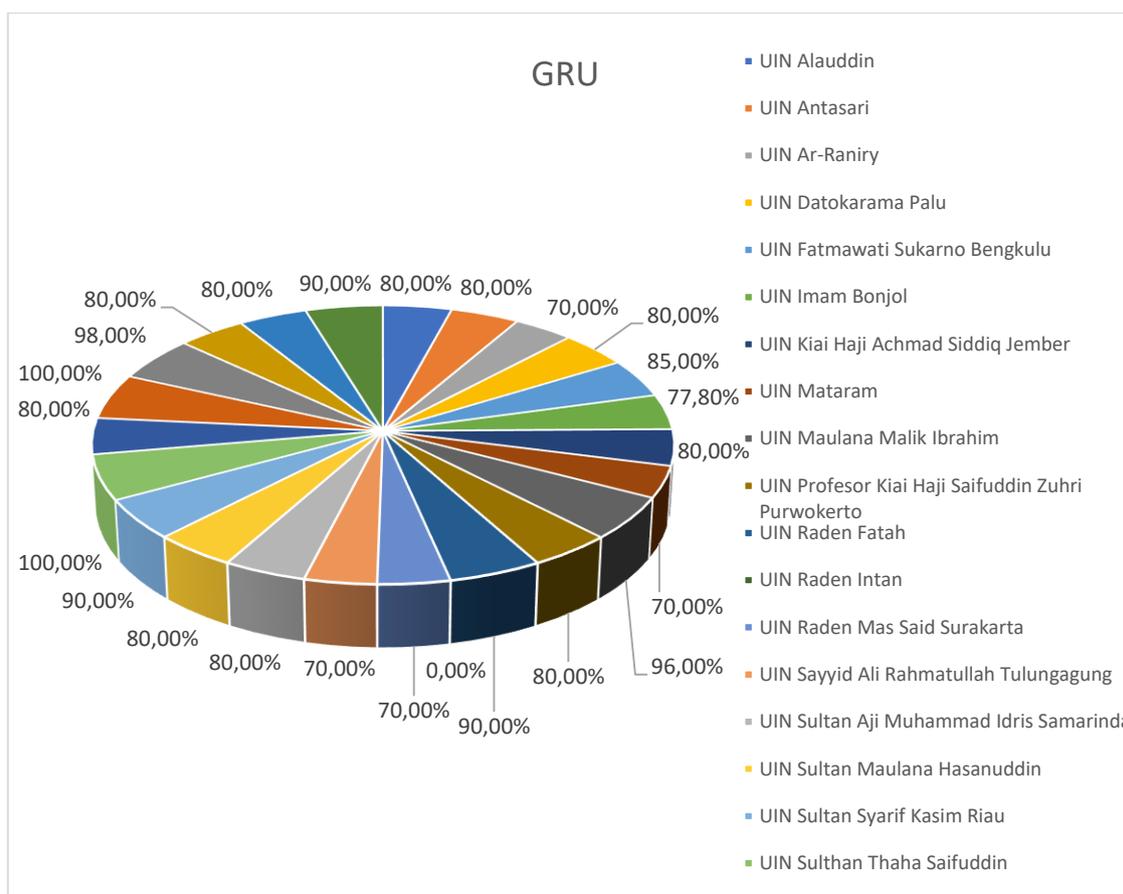
**Figure 8.** PTKIN's achievement on indicators of the number of business unit programs relevant to the study program

According to Figure 8, PTKIN includes UIN Maulana Malik Ibrahim Malang, UIN Raden Fatah, UIN Sultan Aji Muhammad Idris Samarinda, and UIN Sultan Maulana Hasunuddin, who have the greatest percentage values in these sub-indicators.

With four colleges, PTKIN, which receives the greatest percentage value for pertinent business unit programs, demonstrates the need for improvement in competitive excellence. In a changing corporate environment, competitive advantage is a prerequisite for higher education globally and merits specific attention [29]. Higher education's competitive advantage is built on a number of factors, including learning quality, research, innovation, reputation, image, and partnerships with stakeholders [30].

### **GRU Indicator Achievement**

The realization of civil society in the university environment is one of the GRU indicator's sub-indicators. The percentage of these sub-indicators is shown in Figure 9 below.



**Figure 9.** The achievement of PKTIN on the GRU indicators (the realization of civil society in the university environment)

UIN Mataram, UIN Raden Mas Said Surakarta, and UIN Sayyid Ali Rahmatullah Tulungagung have the lowest percentages of PTKIN when calculated using the proportion of these sub-indicators. The UINs Maulana Malik Ibrahim Malang, Sunan Gunung Djati, Sultan Thaha Saifuddin, and Sunan Ampel are all part of PTKIN, which has the greatest percentage.

The establishment of civil society within the institution is a sign that the GRU indicators have been met. Public Sector International recognition is a characteristic of higher education. PTKIN needs to create and carry out international-standard operations in order to be recognized on a global scale. To do this, strategic measures must be taken, such as transforming the audience into actors, pursuing academic diplomacy on an international scale, sending lecturers abroad, enhancing foreign language proficiency, implementing administrative management that adheres to international standards, and stepping up research efforts [31].

### Cluster Analysis Results

Some of the SPSS outputs from the PTKIN grouping's cluster analysis based on the WCU readiness indicators, which are shown in Table 1, are shown below.

**Table 1.** PTKIN grouping cluster analysis outcome from SPSS.

	<b>Initial Cluster Centers</b>		
	Cluster		
	1	2	3
X1	.10	.03	.15
X2	.74	.65	.45
X3	.71	.19	.37
X4	.76	.50	.41
X5	.76	.79	.48
X6	1.00	.20	.00
X7	1.00	.08	.00
X8	.90	1.00	.00
X9	.54	.68	.31
X10	1.00	.00	.67
X11	1.00	.00	.75
X12	1.00	.00	.75
X13	.98	.80	.70
X14	.90	.80	.64
X15	.97	.60	.81
X16	.90	.98	.81
X17	.98	.90	.57
X18	1.00	.72	.63
X19	.82	.68	.40
X20	1.00	.80	.89
X21	.98	.96	.77
X22	.98	.90	.53
X23	1.00	1.00	1.00
X24	1.00	1.00	1.00
X25	1.00	.75	1.00
X26	.20	1.00	.20
X27	1.00	1.00	.13
X28	1.00	1.00	1.00
X29	1.00	1.00	.00
X30	.39	.00	.00
X31	.50	1.00	.00

Table 1 shows the first perspective of the clustering process prior to the iteration phase and comprises the initial cluster center values. The iteration procedure is described in Table 2.

**Table 2.** Information Iteration Process

Iteration	Iteration History <sup>a</sup>		
	Change in Cluster Centers		
n	1	2	3
1	1.161	1.205	1.381
2	.000	.000	.000

a. Convergence achieved due to no or small change in cluster centers. The maximum absolute coordinate change for any center is .000. The current iteration is 2. The minimum distance between initial centers is 2.512.

In order to achieve the best findings, the analysis' iteration procedure is repeated a certain amount of times, as shown in Table 2. Table 2's results show that the iteration procedure required two iterations to produce the best possible cluster outcomes. Additionally, 2.512 is the minimum distance between the cluster centers created as a result of the iteration outcomes. The calculation results manually to calculate the distance of each variable using the following formula.

$$d_{11} = \sqrt{(x_1 - c_{11})^2 + (x_2 - c_{21})^2 + (x_3 - c_{31})^2 + (x_4 - c_{41})^2 + \dots + (x_{31} - c_{311})^2}$$

And the result such the following calculation

$$d_{11} = \sqrt{(0,4 - 0,10)^2 + (0,25 - 0,74)^2 + (0,91 - 0,71)^2 + (0,53 - 0,76)^2 + (0,12 - 0,76)^2 + \dots + (0,5 - 0,39)^2 + (0,6 - 0,50)^2} = 2,042$$

$$d_{12} = \sqrt{(0,4 - 0,03)^2 + (0,25 - 0,65)^2 + (0,91 - 0,19)^2 + (0,53 - 0,50)^2 + (0,12 - 0,79)^2 + \dots + (0,5 - 0)^2 + (0,6 - 1)^2} = 4,511$$

$$d_{13} = \sqrt{(0,4 - 0,15)^2 + (0,25 - 0,45)^2 + (0,91 - 0,37)^2 + (0,53 - 0,41)^2 + (0,12 - 0,48)^2 + \dots + (0,5 - 0)^2 + (0,6 - 0)^2} = 1,306$$

$$d_{21} = \sqrt{(0,91 - 0,10)^2 + (0,85 - 0,74)^2 + (0,84 - 0,71)^2 + (0,53 - 0,76)^2 + (0,85 - 0,76)^2 + \dots + (0,50 - 0,39)^2 + (0,64 - 0,50)^2} = 5,042$$

$$d_{22} = \sqrt{(0,91 - 0,03)^2 + (0,85 - 0,65)^2 + (0,84 - 0,19)^2 + (0,53 - 0,50)^2 + (0,85 - 0,79)^2 + \dots + (0,50 - 0)^2 + (0,64 - 1)^2} = 1,413$$

$$d_{13} = \sqrt{(0,91 - 0,15)^2 + (0,85 - 0,45)^2 + (0,84 - 0,37)^2 + (0,53 - 0,41)^2 + (0,85 - 0,48)^2 + \dots + (0,50 - 0)^2 + (0,64 - 0)^2} = 3,412$$

From calculating the distance to the first variable, the distance to cluster 1 is 2,042, the distance to cluster 2 is 4,511 and the distance to cluster 3 is 1,306. Based on these calculations, it is found that the distance to cluster 3 is the shortest distance so that the first variable is grouped into the third cluster. Likewise for the second variable, the distance value for cluster 1 is 5,042, the distance for cluster 2 is 1,413, and the distance for cluster 3 is 3,412. So the shortest distance is 3,412 and it can be concluded that the second variable is grouped in the second cluster. And the same calculation is also carried out for the 24 variables grouped into 3 clusters

**Table 3.** Membership of the 3 clusters formed

<b>Cluster Membership</b>			
Case Number	VAR	Cluster	Distance
1	UIN Alauddin	3	1.306
2	UIN Antasari	2	1.413
3	UIN Ar-Raniry	3	1.381
4	UIN Datokarama Palu	3	1.148
5	UIN Fatmawati Sukarno Bengkulu	3	.944
6	UIN Imam Bonjol	3	1.560
7	UIN Kiai Haji Achmad Siddiq Jember	3	1.260
8	UIN Mataram	3	1.088
9	UIN Maulana Malik Ibrahim Malang	1	1.178
10	UIN Profesor Kiai Haji Saifuddin Zuhri Purwokerto	2	.973
11	UIN Raden Fatah	2	1.266
12	UIN Raden Intan	1	1.779
13	UIN Raden Mas Said Surakarta	2	1.277
14	UIN Sayyid Ali Rahmatullah Tulungagung	3	1.258
15	UIN Sultan Aji Muhammad Idris Samarinda	2	1.205
16	UIN Sultan Maulana Hasanuddin	3	.991
17	UIN Sultan Syarif Kasim Riau	1	1.170
18	UIN Sulthan Thaha Saifuddin	1	1.352
19	UIN Sumatera Utara	3	1.093
20	UIN Sunan Ampel	1	.871
21	UIN Sunan Gunung Djati	1	1.161
22	UIN Sunan Kalijaga	1	.946
23	UIN Syarif Hidayatullah	1	1.363
24	UIN Walisongo	1	1.093

The membership of the created clusters is displayed in Table 3. It is clear that the 1<sup>st</sup> Cluster with the PTKIN category has members such as UIN Walisongo, UIN Syarif Hidayatullah, UIN Sunan Kalijaga, UIN Sunan Gunung Djati, UIN Sunan Ampel, UIN Sulthan Thaha Saifuddin, UIN Raden Intan, UIN Sultan Syarif Kasim Riau, and UIN Maulana Malik Ibrahim Malang. Meanwhile, UIN Sultan Aji Muhammad Idris Samarinda, UIN Raden Mas Said Surakarta, UIN Raden Fatah, UIN Professor Kiai Haji Saifuddin Zuhri, and UIN Antasari are among the members of the 2<sup>nd</sup> cluster with the PTKIN category who are prepared to enroll in a top institution. In addition, UIN North Sumatra, UIN Sultan Maulana Hasanuddin, UIN Sayyid Ali Rahmatullah Tulungagung, UIN Ar-Raniry, UIN Datokarama Palu, UIN Fatmawati Sukarno Bengkulu, UIN Imam Bonjol, UIN Kiai Haji Achmad Siddiq Jember, UIN Mataram and UIN Alauddin are PTKIN classified as not ready to go to WCU based on the e-sms indicator used.

Thus, it may be inferred that Table 4's depiction of the number of cluster memberships is accurate.

**Table 4.** Cluster membership

Number of Cases in each Cluster	
Cluster 1	9.000
2	5.000
3	10.000
Valid	24.000
Missing	.000

According to Table 4, PTKIN has 9 PTKIN that fall under the category of being "very ready to become WCU" in the first cluster, 5 PTKIN that fall under the category of "ready to become WCU" in the second cluster, and 10 PTKIN that fall under the category (third cluster) of "not ready to become WCU" based on the analyzed e-SMS indicator. Tables 5 and 6 display the significance scores for each e-SMS indicator utilized in the analysis.

**Table 5.** Distance Between Final Clusters and centers  
Distances between Final Cluster Centers

Cluster	1	2	3
1		1.289	1.209
2	1.289		1.187
3	1.209	1.187	

Berikut ini Tabel 6 mengenai Anova.

**Table 6.** Anova

ANOVA							
	Cluster			Error		F	Sig.
	Mean Square	df	Mean Square	df			
	1	2	3	4	5	6	7
VAR00002	.033		2	.014	21	2.354	.120
VAR00003	.005		2	.026	21	.178	.839
VAR00004	.095		2	.029	21	3.250	.059
VAR00005	.093		2	.043	21	2.164	.140
VAR00006	.063		2	.035	21	1.779	.193
VAR00007	.731		2	.151	21	4.825	.019
VAR00008	.827		2	.090	21	9.156	.001
VAR00009	.197		2	.129	21	1.536	.239
VAR00010	.064		2	.019	21	3.437	.051
VAR00011	.011		2	.189	21	.057	.945
VAR00012	.062		2	.077	21	.803	.461
VAR00013	1.072		2	.046	21	23.239	.000
VAR00014	.068		2	.034	21	2.009	.159
VAR00015	.090		2	.012	21	7.318	.004
VAR00016	.049		2	.013	21	3.836	.038
VAR00017	.010		2	.019	21	.522	.601
VAR00018	.063		2	.015	21	4.263	.028
VAR00019	.044		2	.019	21	2.272	.128

**Lanjutan Tabel 6. Anova**

1	2	3	4	5	6	7
VAR00020	.016	2	.046	21	.346	.711
VAR00021	.003	2	.007	21	.341	.715
VAR00022	.049	2	.017	21	2.916	.076
VAR00023	.090	2	.019	21	4.830	.019
VAR00024	.073	2	.070	21	1.031	.374
VAR00025	.035	2	.009	21	3.938	.035
VAR00026	.013	2	.022	21	.574	.572
VAR00027	.165	2	.085	21	1.932	.170
VAR00028	.168	2	.079	21	2.133	.143
VAR00029	.022	2	.036	21	.620	.547
VAR00030	1.032	2	.166	21	6.221	.008
VAR00031	.148	2	.055	21	2.697	.091
VAR00032	.290	2	.153	21	1.904	.174

The significance score for each e-SMS indicator utilized in the analysis may be seen in Table 6. The table can be used to compare the results of the clusters made using different indicators; in this case, the F value and significance value produced by each indication show the difference. In conclusion, the difference in indicators within the established cluster increases with increasing F value and significance value 0.05. The four metrics that most clearly show the difference between PTKIN are therefore found in the three clusters, according to the table. As can be observed, the four sub-indicators' F values are higher than those of the other sub-indicators.

Based on data analysis, there are 3 clusters of PTKIN readiness for WCU, namely first cluster for the PTKIN category which is very ready, second cluster with PTKIN category that is ready, and third cluster classified as not ready. Table 7 lists the PTKIN clusters going to WCU.

**Table 7. PTKIN readiness clusters for WCU**

No	First Cluster	Second Cluster	Third Cluster
1	UIN Sunan Ampel	UIN Profesor Kiai Haji Saifuddin Zuhri Purwokerto	UIN Fatmawati Sukarno Bengkulu
2	UIN Sunan Kalijaga	UIN Sultan Aji Muhammad Idris Samarinda	UIN Sultan Maulana Hasanuddin
3	UIN Walisongo	UIN Raden Fatah	UIN Mataram
4	UIN Sunan Gunung Djati	UIN Raden Mas Said Surakarta	UIN Sumatera Utara
5	UIN Sultan Syarif Kasim Riau	UIN Antasari	UIN Datokarama Palu
6	UIN Maulana Malik Ibrahim Malang		UIN Sayyid Ali Rahmatullah Tulungagung
7	UIN Sulthan Thaha Saifuddin		UIN Kiai Haji Achmad Siddiq Jember
8	UIN Syarif Hidayatullah		UIN Alauddin
9	UIN Raden Intan		UIN Ar-Raniry
10			UIN Imam Bonjol

PTKIN comprises UPI sub-indicators for the following three clusters: number of activities (training and workshops), improvement of moderation, and application of performance reviews among directors general. Regular monitoring and follow-up of budget execution has been done in the higher education sub-indicators of the GUG, namely the Amanah indicators for faculty leaders with networking leadership. PTKIN, which is very prepared to accomplish WCU, is present in the first cluster. PTKIN ready can be found in the second cluster. And PTKIN, which is not yet prepared to actualize WCU, is present in the third cluster.

Realizing WCU is a reputable institution, PTKIN must take strategic actions, such as increasing the quantity and quality of research outputs, providing high-quality teaching services, and, as necessary, developing a website, providing leadership, implementing GUG, working with other institutions, and expanding PTKIN internationally [10]. Achieving an international standard university requires careful planning, supporting infrastructure, input from stakeholders, support from stakeholders, and organizational commitment from academics, staff, and students [10]. A supporting effort to build a university with a reputation for WCU is the development of the character of professors and staff who have academic ethics with rational, objective, and normative features [32].

## **CONCLUSIONS**

Data analysis findings lead to the conclusion that not all achievement markers have been met by PTKIN for each WCU indicator employed in the Electronic Strategic Management System (e-SMS), namely GUG, UPI, CAU, and GRU. To attain WCU, PTKIN needs a solid GUG foundation in order to perform well at the UPI stage, go on to the CAU, and finally complete the GRU. To have a beneficial social influence on the community, PTKIN must be able to become a top university in terms of governance, leadership, research, and education. To do this, a lot of effort and assistance from several sources is required.

There developed three clusters. PTKIN category member UIN Walisongo, UIN Syarif Hidayatullah, UIN Sunan Kalijaga, UIN Sunan Gunung Djati, UIN Sunan Ampel, UIN Sulthan Thaha Saifuddin, UIN Raden Intan, UIN Sultan Syarif Kasim Riau, and UIN Maulana Malik Ibrahim Malang are among the members of first cluster. Meanwhile, UIN Sultan Aji Muhammad Idris Samarinda, UIN Raden Mas Said Surakarta, UIN Raden Fatah, UIN Professor Kiai Haji Saifuddin Zuhri, and UIN Antasari are among the PTKIN category members in second cluster who are prepared to enroll in a top institution. In addition, UIN North Sumatra, UIN Sultan Maulana Hasanuddin, UIN Sayyid Ali Rahmatullah Tulungagung, UIN Ar-Raniry, UIN Datokarama Palu, UIN Fatmawati Sukarno Bengkulu, UIN Imam Bonjol, UIN Kiai Haji Achmad Siddiq Jember, UIN Mataram and UIN Alauddin are UIN classified as not ready to go to WCU based on the e-SMS indicator used.

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