# Economic Analysis of Research and Innovation Activities of Technical Higher Education Institutions in Zarafshan Region

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Abstract: In the article, analyses based on the author's methodological approach to the scientific research and innovative activities of technical higher education institutions located in the Zarafshan economic region are provided. The main findings and proposals for enhancing the effectiveness of scientific research and innovative activities are also presented by the results of the analysis.

## 1 INTRODUCTION

The Zarafshan economic region is located within the administrative boundaries of the Bukhara, Navoi, and Samarqand regions of the Republic of Uzbekistan. In the Zarafshan economic region, there are a total of five higher education institutions specializing in various technology fields that have been actively operating over the last decade. These institutions include the Bukhara Engineering and Technology Institute (BETI), Bukhara Institute for Managing Natural Resources (BIMNR), Samarkand State University of Architecture and Construction (SSUAC), Tashkent University of Information Technologies named after Muhammad al-Khwarizmi, Samarqand Branch (TUITSamB), and Navoi State Mining and Technology University (NSMTU). Given the significant role played by these technical higher education institutions in the socio-economic development of the region, evaluating the effectiveness of their scientific research and innovative activities has become increasingly crucial in recent years.

## 2 METHODS

Methods for evaluating the scientific research and innovative activities of higher education institutions are not only described in the assessment areas but also the tools, indicators, and instruments used, with noticeable variations. Indeed, providing an accurate assessment of scientific and innovative activity requires creating favorable conditions for making well-founded decisions based on comprehensive, objectively assessed factors that influence it.

The history of interest in assessing the effectiveness of scientific research and innovation in global practice is quite extensive. However, the systematic emergence of these approaches began in the late 19th century with the quantification of productivity in scientific evaluation, and this should not be considered a mistake (Godin, 2009). In many cases, these efforts were initially linked to the monetization of research (Godin, 2009), and most of these activities were connected with the financial evaluation of research. Bibliometric indicators have been considered one of the main tools in evaluating

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the scientific competence of individuals or institutions (Hicks, Wouters, Waltman, de Rijcke, 2015). The development of bibliometrics has brought with it the utilization of quantitative measures in assessing the effectiveness of scientific and innovative activities. Notably, the number of research publications, the impact factor of journals, and citations were used as criteria contributing to the assessment of productivity. Such conditions have shaped the focus of scientific articles toward a centralized factor. In 1926, Alfred J. Lotka introduced the concept of "Lotka's law," where he focused on the slowing down of the number of publications in his significant work (Lotka, 1926). Research productivity is a creative process in which the production of information involves human, material (scientific tools, materials, etc.), and non-material (accumulated knowledge, social relations, economic rents, etc.) resources, resulting in the product as new knowledge (Abramo, D'Angelo, 2014).

Currently, various international rankings and methods, such as the ARWU-Academic Ranking of World University (Shanghai Ranking Consultancy), QS World University Rankings (QS Quacquarelli Symonds Limited) , THE-World University Rankings, ARES-Higher Education Institutions Ranking (European Academy of Sciences and Arts), widely assess the effectiveness of the innovative activities of higher education institutions. These rankings utilize different methods and indicators. Among the indicators used to evaluate university activities, the quality of scientific research is given the highest weight, for example, 20% in QS/USNews, 40% in ARWU (Docampo, 2010), 70% in THE, and 100% in Leiden (Florian, 2007).

In Uzbekistan, the level and quality of the scientific and pedagogical activities of higher education institutions have been assessed based on a comprehensive ranking system since December 29, 2012. This evaluation system was established by the Cabinet of Ministers Resolution No. 371 and includes four main criteria and a total of 20 indicators ( Fig 1).

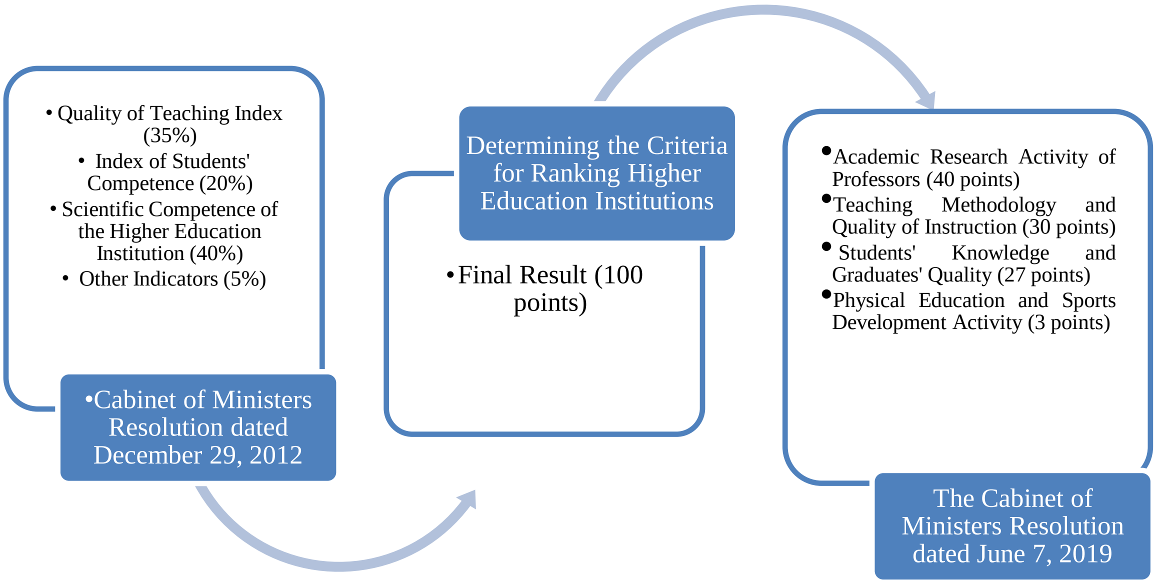



Figure 1: Structure of the Ranking System for Higher Education Institutions in Uzbekistan (Hazelkorn, 2011).

Later, on June 7, 2019, the Cabinet of Ministers issued Resolution No. 467, "On Measures to Improve the Procedure for Determining the Ranking of Higher Education Institutions," which marked the transition to the national ranking of higher education institutions. In the national ranking, within the category of the academic research activity of professor-instructors (40 points), the indicator of the impact of publications on international indicators carries the highest weighting coefficient (9 points).

In addition to numerous global or national rankings for assessing innovative activities, there are various proposed methodologies for evaluating the scientific and innovative activity of higher education institutions. The analysis of the essence of the concept proposed by K.S. Grishenko, I.I. Dyakov, N.A. Tretyak revealed the following functional components of the university's innovative environment: scientific component, personnel composition component, organizational component, and financial component.

According to the authors, each component is described using a system of indicators, based on which specific small indices are calculated. This, in turn, allows for a more detailed description of the overall development level of the innovative environment, revealing the share of each component, identifying the interdependence between indicators, and providing a systematic assessment of the overall development level (D'yakov, Tret'yak, Grishchenko, 2018). Author groups led by M. Vasilyeva, E. Reale, and D. Yu. Busigin have proposed specific mathematical expressions for evaluating scientific research and innovative activities (Table 1).

Table 1: Comparative Analysis of Authorship Methodologies for Evaluating the Efficiency of Scientific Research and Innovative Activities.

| № | The authors | **Formula** | Conditional signs |
|---|---|---|---|
| 1 | M.Vasiljeva V.Ponkratov, T.Volkova, S.Khairova, N.Nikitina, O.Dudnik, M.Alimova, N.Kuznetsov, I.Elyakova (Vasiljeva, Ponkratov, Volkova, Khairova, Nikitina, Dudnik, Alimova, Kuznetsov, Elyakova, 2020) | $P_{ik} = \left[b_{ik} / \sum b_{ik}\right] \times \left[\sum e_k / (m-1)\right],$ $p_i = \sum p_{ik}$ | ***pi*** *– i-th factor - expert assessment of the significance coefficient;*<br>***bik*** *- assessment of k-expert regarding the importance of i-factor (b=1,10);*<br>$\sum \boldsymbol{b_{ik}}$ *- Sum of k-expert scores for all factors;*<br>***t*** *– be a number of factors*<br>$\sum \boldsymbol{e_k} / (\boldsymbol{m} - \mathbf{1})$ *- k-expert qualification coefficient;*<br>*∑ek – the sum of binary values (e = 0 ∩ 1, “0” — the expert considers the k-expert to be incompetent and considers it inappropriate to include him/her in the expert group; «1» — expert indicates that the k-th expert is needed in the group), taking into account the competence of the k-th expert of the given expert group (m - 1 expert);*<br>***m****- number of experts in the expert group.* |
| 2 | E.Reale, D.A.DeFilippo, I.Gómez, B.Lepori, B.Potì, E.Primeri, C.Probst,E.S. Casado (Reale, DeFilippo, Gómez, Lepori, Potì, Primeri, Probst, Casado, 2011) | $F_i = \sum k_{ji} \times X_{nj}$ | $\boldsymbol{F_i}$ *- i-coefficient of the result of the scientific activity of a teacher;*<br>$\boldsymbol{k_{ji}}$ *- coefficient of linear regression equations describes the relative importance of the j-th indicator within the i-th factor;*<br>$\boldsymbol{X_{nj}}$*- normalised value of j-th indicator;*<br>***i****- factor number;*<br>***j****- serial number of the indicator;*<br>***n****- the number of indicators of the effectiveness of the teacher's scientific activity.* |
| 3 | D.Yu.Busigin (Busygin, 2020) | $\mathrm{Eki} = \frac{(\mathrm{VV} + \mathrm{VB} + \mathrm{RG})\mathrm{Kd}}{\mathrm{ID} + \mathrm{SV}}$ | ***Eki*** *- efficiency of the process of commercialization of university innovations;*<br>***VV*** *- the benefit of the university from the commercialization of university innovations;*<br>***VB*** *- business benefits from commercialization of university innovations;*<br>***RG*** *- the volume of state investments aimed at the commercialization of innovations created at the university;* |

| | | | |
|---|---|---|---|
| | | | ***Kdost*** *- coefficient of use of a specific form of commercialization of innovations created at the university;* ***ID*** *- transaction costs arising from the commercialization of university innovations;* ***CB*** *- costs of introducing university innovations.* |

# 3 RESULTS

The study of scientific sources in the field of economics indicates that most research groups extensively utilize information collected from a wide range of sources for evaluating various aspects of scientific research and innovative activities, as well as assessing higher education institutions (HEIs). It has been highlighted that there is a necessity to extract valuable information from diverse sources, especially the data provided by higher education institutions themselves, the websites of state educational authorities and other organizations, national and international bibliometric materials, and the direct results obtained during the evaluation of HEIs through surveys. However, the results of the research on the use of such broad-spectrum information have not yet demonstrated an improvement in the quality of obtained results, particularly due to certain inconveniences. In addition to the challenges faced by companies developing such research and rankings, the evaluated universities also recognize the complexity of such approaches, acknowledging the significant amount of labor and information resources required. Moreover, it is essential to establish collaboration formats with ranked universities, choose methods for verifying obtained information, and simplify the process of collecting and reanalyzing remaining data, ensuring its reliability and integrity. These methodological issues, along with the need to ensure the practicality and reliability of the process, remain unresolved challenges in research and rankings.

In order to eliminate the shortcomings of methodical approaches used to evaluate the scientific and innovative activities of subjects, we propose a system called the "Indicators System for Evaluating Scientific and Innovative Activities of Subjects" on our part. By the rules, benchmarks for each indicator are determined by the average arithmetic mean of the three highest values of the indicator, aiming to liberate from the influence of the maximum indicators of individual subjects and giant indicators of HEIs. For this purpose, the average arithmetic mean of the three highest values of each indicator is identified, and the benchmark indicator is set equal to 100 points. It is determined with the following statements.

$$\frac{RES_{max} + RES_{max-1} + RES_{max-2}}{3} = RES_{etalon} \quad (1)$$

$$\frac{POT_{max} + POT_{max-1} + POT_{max-2}}{3} = POT_{etalon} \quad (2)$$

$$\frac{EFF_{max} + EFF_{max-1} + EFF_{max-2}}{3} = EFF_{etalon} \quad (3)$$

The system proposed by us, referred to as the "Indicators System for Evaluating Scientific and Innovative Activities of Organizations of Targeted Management (HEIs)," consists of three subsystems:

1. The first subsystem is named "Indicators of Scientific and Innovative Activity Results" and is dedicated to evaluating 20 indicators grouped into three conditional categories ($RES_i$) for a combined assessment.

I. PUBLICATION RESULTS CONDITIONAL GROUP:

- Number of scientific articles (published in foreign scientific journals selected by higher certification commission), $RES_1$.
- Number of scientific articles (published in Republic scientific journals selected by higher certification commission), $RES_2$.
- Number of articles indexed in Web of Science and Scopus, $RES_3$.
- Number of citations in Web of Science and Scopus journals over the last 5 years, $RES_4$.
- Number of published monographs, $RES_5$.
- Number of published textbooks, $RES_6$.
- Number of published teaching materials, $RES_7$.

II. SCIENTIFIC-RESEARCH RESULTS CONDITIONAL GROUP:

- Number of successfully defended dissertations (PhD, DSc), $RES_8$.
- Amount of funding from foreign and international scientific research grants, $RES_9$.
- Amount of funding from national sources, $RES_{10}$.
- Amount of funding from local sources, $RES_{11}$.

III. INNOVATIVE ENTREPRENEURSHIP RESULTS CONDITIONAL GROUP:

- Revenue from selling intellectual property objects under license agreements, $RES_{12}$.

- Number of patents obtained for inventions, utility models, industrial designs, and selection achievements, $RES_{13}$.

- Number of agreements and licenses for databases and electronic information systems protected by copyright, $RES_{14}$.

- Revenues from licensing agreements, $RES_{15}$.

- Number of startups created under innovative projects, $RES_{16}$.

- Number of innovation enterprises established under innovative projects, $RES_{17}$.

- Number of new jobs created as a result of innovative entrepreneurship, $RES_{18}$.

- Number of innovation startups, $RES_{19}$.

- Number of scientific, innovative, and technological projects implemented in collaboration with foreign organizations, $RES_{20}$.

The total score for each HEI`s scientific and innovative activity results is determined by the following formula:

$$SUMRES^n = \sum_{i=1}^{20} \frac{RES_i^n}{RES_{(i)etalon}} \cdot 100 \qquad (4)$$

Here,

$SUMRES^n$- *represents the total score for the indicators;*

$RES_i^n$- *denotes the performance indicator of the "i" result for the "n" subjects being evaluated;*

$RES_{(i)etalon}$- *stands for the benchmark indicator of the "i" result.*

The second subsystem is named "Indicators of Scientific and Innovative Competence," denoted as $POT_j$, and includes the following indicators:

- Number of professors and teachers, $POT_1$.
- Number of academic degree holders (PhD, DSc) (excluding the reporting year), $POT_2$.
- Number of doctoral students (PhD, DSc, independent researchers, intern-researchers), $POT_3$.
- Number of master's students, $POT_4$.
- Number of scientific staff, $POT_5$.
- Number of existing intellectual property objects (excluding the reporting year), $POT_6$.
- Number of scientific-research laboratories, $POT_7$.
- Number of innovation enterprises (excluding the reporting year), $POT_8$.
- Number of experimental-design-construction departments (enterprises), $POT_9$.

The total score for the indicators of scientific and innovative competence of each educational institution is determined by the following formula:

$$SUMPOT^n = \sum_{j=1}^{9} \frac{POT_j^n}{POT_{(j)etalon}} \cdot 100 \qquad (5)$$

Here,

$SUMPOT^n$- *the sum of system potential indicators;*

$POT_j^n$-*"j" indicator of the potential "n" of the subject whose activity is being studied;*

$POT_{(j)etalon}$- *"j" - standardised indicator of potential*

The indicators of the 3rd system are called "Performance indicators of research and innovation activity" and are found by dividing separately obtained indicators of the 1st system by individual indicators of the 2nd system ($EFF_{ij}$) and all performance indicators of HEIs by the sum of indicators are as follows:

$$\text{SUMEFF}= \sum_{i=1,j=1}^{i=20,j=9} \frac{RES_i^n}{EFF_j^n} \cdot 100 \qquad (6)$$

When implementing the proposed methodology, it is necessary to pay attention to the following features:

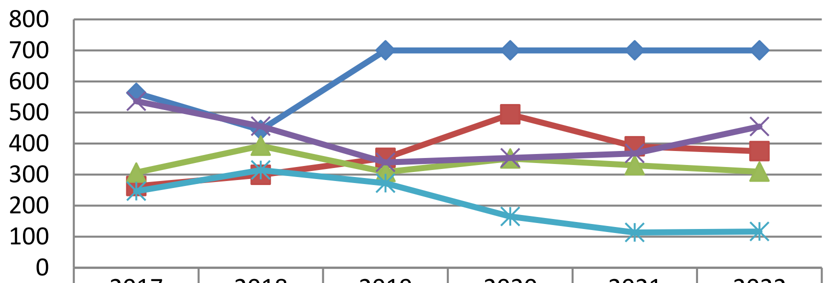
- it is determined to what extent the subject, whose activity is studied, is from the standard of the corresponding indicator (here it should be noted that even if the corresponding indicator of the subject involved in the calculation of the standard is higher than the standard, it is still accepted, as 100 points will be fulfilled);
- the sum of the indicators within each system determines the overall level of the subject;
- On which indicators the HEI has the lowest and highest scores among similar HEIs;
- measures will be developed to strengthen strengths and develop weak indicators among similar HEIs.

# 4 DISCUSSION

Based on the developed methodology, the indicators of results and potential indicators of research and innovation activity in technical universities of the Zarafshan region of the Republic of Uzbekistan (Bukhara, Samarkand, Navoi) for 2017-2022, scientific research and efficiency are analyzed indicators of innovation activity are determined.

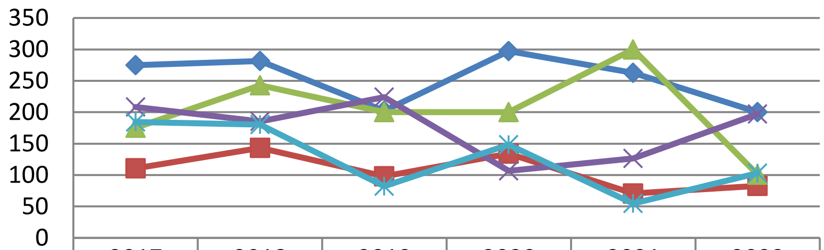
Calculations show by the dynamics of change of indicators of results of research and innovation activity of technical institutions of the region that BETI took the main place in the conditional group of publication results. For 2017-2022, BETI results were above the normative indicator in the conditional group of publication results in almost all cases, in 35 cases out of 42 it was above the normative indicator. SSUAC stands out in the next place, in 8 out of 42 opportunities it was above the benchmark. In NSMTU, there were 4 of 42 such results out of 42 possibilities. (Fig. 2).

NSMTU 2017-2022 on the conditional group of research results out of 15 opportunities (actually there should be 24 opportunities, but we stopped at 18 opportunities because no HEI has not utilized funds from local sources ($RES_{11}$)) led to 12 of them. In particular, over the last 6 years, NSMTU has moved forward with PhD and DSc theses. The next place in this conditional group went to BETI, i.e. it advanced in 7 opportunities out of 18.




| | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|
| BETI | 563,4 | 443,8 | 700 | 700 | 700 | 700 |
| BIMNR | 262,75 | 299,16 | 353,7 | 493,75 | 390,69 | 375,78 |
| NSMTU | 306,72 | 392,44 | 308,09 | 351,4 | 329,64 | 309,38 |
| SSUAC | 536,51 | 455,31 | 339,3 | 353,24 | 367,7 | 455,01 |
| TATUSamF | 247 | 314,45 | 272,35 | 164,89 | 113,64 | 116,17 |

Figura 2: Dynamics of indicators of the conditional group of publication results in technical universities of the Zarafshan region.

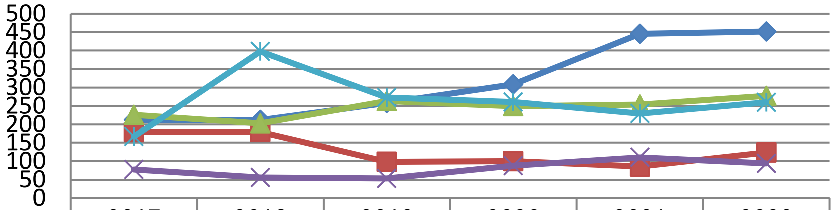



| | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|
| BETI | 275 | 281,42 | 202,21 | 297,27 | 262,47 | 200,19 |
| BIMNR | 110,46 | 143,18 | 97,85 | 133,84 | 70,73 | 82,66 |
| NSMTU | 175,16 | 242,77 | 200 | 200 | 300 | 100,75 |
| SSUAC | 208,19 | 185,41 | 224 | 106,71 | 126,29 | 196,85 |
| TUITSamB | 184,4 | 180,57 | 81,99 | 148,37 | 54,63 | 102,82 |

Figure 3: Dynamics of indicators of the conditional group of R&D results in technical universities of the Zarafshan region.

It is difficult to find a clearly advanced leader of the innovative entrepreneurship group according to the results of 2017-2022. Relatively BETI was leading in 15 opportunities out of 30 (actually there should have been 42 opportunities, but according to the indicators of sale of intellectual property based on license agreements ($RES_{12}$), ($RES_{18}$) no facts were observed in any HEI. ). Samarkand branch of TUIT ranked next and was above the benchmark in 10 out of 30 opportunities. NSMTU was leading in 9 out of

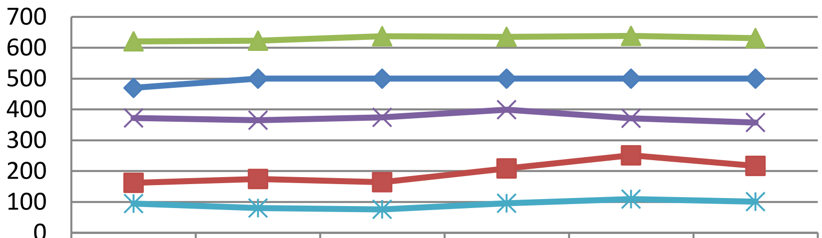
30 opportunities. It should also be noted that NSMTU has not lost its leadership for the last 6 years in terms of revenue from economic contracts ($RES_{15}$). As the highest example of integration of science, education, and production, NSMTU's ties with such industrial and production enterprises as Navoi Mining and Metallurgical Combine (Navoi Azot OJSC, Kizilkumsement OJSC) are commendable.




| | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|
| BETI | 212,03 | 211,89 | 258,34 | 308,69 | 445,29 | 451,7 |
| BIMNR | 178,73 | 179,02 | 98,08 | 100,38 | 85,63 | 123,09 |
| NSMTU | 226,26 | 202,8 | 262,96 | 248,99 | 253,62 | 277,32 |
| SSUAC | 77,88 | 55,42 | 53,2 | 87,81 | 110,05 | 94,15 |
| TUITSamB | 166,58 | 397,64 | 272,85 | 260,39 | 229,68 | 259,88 |

Figure 4: Dynamics of indicators of the conditional group of innovation entrepreneurship results in the universities of the technology sector of the Zarafshan region.

The number of professors and teachers ($POT_1$), the number of academic degrees (Ph.D., DSc) (except for the reporting year) ($POT_2$), the number of doctoral students (Ph.D., DSc, independent BETI researchers, research interns) ($POT_3$), the number of masters ($POT_4$) were leading in terms of numbers. In addition, in 2017-2022, NSMTU is a consistent leader in terms of the number of Master's students ($POT_4$), number of research staff ($POT_5$), number of active intellectual property (except for the reporting year) ($POT_6$). The number of research laboratories ($POT_7$) was in the same place. Of course, the significant growth of these indicators of research and innovation potential is related to the historical development of HEIs. According to the indicators of the number of innovative enterprises (except for the reporting year) ($POT_8$), the number of research and development departments (enterprises) ($POT_9$), the situation is almost the same in all HEIs, that is, in some HEIs there was only a slight positive shift in recent years of research.




| | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|
| BETI | 470,01 | 500 | 500 | 500 | 500 | 500 |
| BIMNR | 162 | 174,66 | 163,66 | 208,85 | 251,24 | 216,5 |
| NSMTU | 620,32 | 622,3 | 637,55 | 634,93 | 638,27 | 631,08 |
| SSUAC | 372,64 | 364,8 | 374,11 | 399,13 | 371,03 | 357,37 |
| TUITSamB | 94,21 | 79,96 | 75,73 | 96,04 | 109,31 | 100,67 |

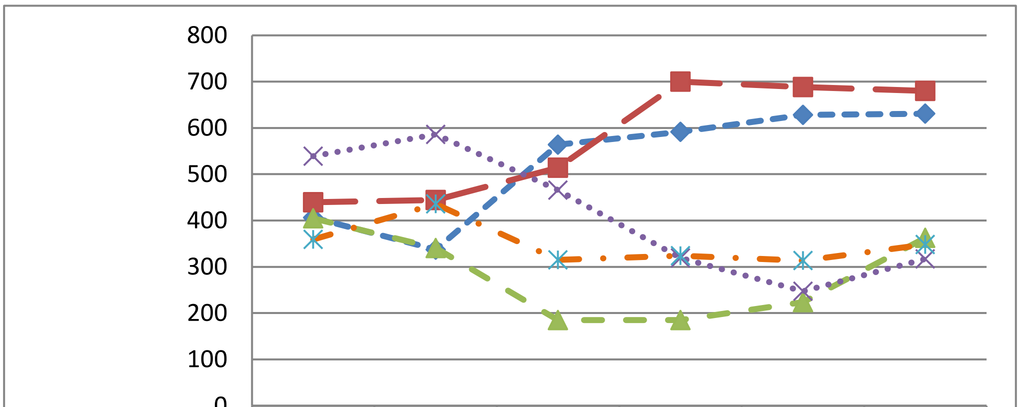
Figure 5: Dynamics of indicators of scientific-innovative potential in higher education institutions in the field of technology in the Zarafshan region.

BIMNR and Samarkand branch of TUIT are significantly inferior in terms of the indicators of the 2nd system, i.e. there was no leadership in any indicator in the years under study. SSUAC demonstrated higher potential compared to the benchmark only in 9 cases out of 54 opportunities.

To facilitate the calculation of the indicator of the efficiency of research and innovation activities of higher education institutions in the Zarafshan region, to give greater reliability to the results, as well as the presence of appropriate restrictions on the volume of publication of research results, all indicators of results ($RES_i$) ) are the most important of higher education institutions, we limited ourselves to dividing by the number of professors and teachers ($POT_1$), which is considered an indicator of capacity. The results of calculating the efficiency of research and innovation activities in technical HEIs in the Zarafshan region are presented. We decided to choose only the number of professors ($POT_1$) from the competence indicators for analysis.

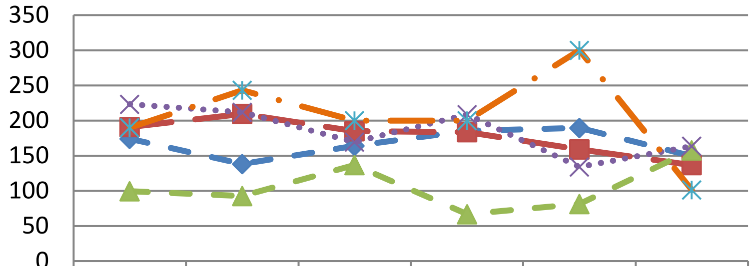
From the research, we see that the favorites have changed by groups of conditions of publication efficiency indicators. For example, BIMNR has strengthened its leadership in this conditional group over the years, and in recent years we can see from the BIMNR example that some indicators in this conditional group are not above the standard indicators, but very close to it. For example, the publication efficiency corresponding to the number of teaching professors at this university is very high. In addition, we can see that the indicators of such HEIs as BETI, and NSMTU, which are among the leaders in other systems in this conditional group of efficiency definition, have significantly decreased, for example, the above-mentioned HEIs are stable in the indicator every year facts of leadership are not distinguished.

As for the conditional group of research efficiency, no HEIs are demonstrating a sharp advantage by the indicators of the previous system. According to the ratio of the number of successfully defended dissertations (Ph.D., DSc) to the number of professors and teachers ($EFF_{8.1}$) and the ratio of the sum of grants received from national sources to the number of professors and teachers ($EFF_{10.1}$) NSMTU, almost all seem to be favorites by years, but this advantage shows relative leadership in this conditional group. It should be noted, however, that due to the lack of grants from local sources, it was not possible to calculate the effectiveness of this indicator.




| | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|
| BETI | 406,61 | 337,31 | 564,21 | 591,83 | 628,41 | 630,7 |
| BIMNR | 439,53 | 444,24 | 513,89 | 700 | 688,34 | 679,97 |
| SSUAC | 404,6 | 340,41 | 184,95 | 184,97 | 223,89 | 363,06 |
| TUITSamB | 539,34 | 586,08 | 465,89 | 319,19 | 247,18 | 317,35 |
| NSMTU | 359,61 | 435,68 | 314,78 | 323,71 | 313,44 | 348,21 |

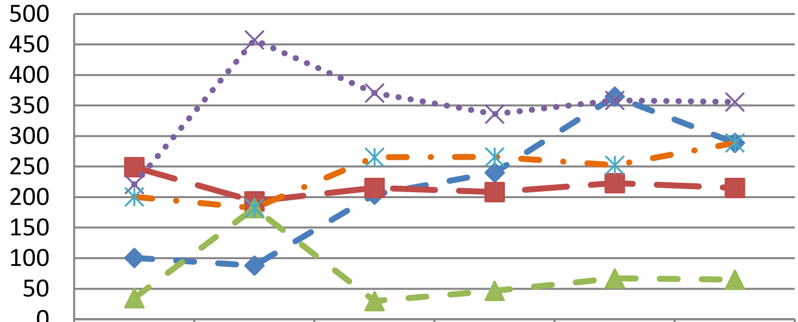
Figure 6: Dynamics of publication efficiency indicators in technical HEIs of the Zarafshan region.



| | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|
| BETI | 173,85 | 138,17 | 163,81 | 185,31 | 189,51 | 149,58 |
| BIMNR | 190,83 | 209,41 | 184,9 | 183,39 | 158,87 | 136,5 |
| SSUAC | 99,58 | 92,34 | 136,56 | 66,72 | 81,26 | 157,7 |
| TUITSamB | 223,23 | 211,88 | 169,42 | 208,49 | 133,94 | 163,57 |
| NSMTU | 189,85 | 243,17 | 200 | 200 | 300 | 101,21 |

.Figure 7: Dynamics of indicators of research efficiency in technical universities of Zarafshan region.

In the conditional group of innovative business efficiency, the Samarkand branch of TUIT has significantly advanced. Such a successful way was conditioned, firstly, by the correct utilization of HEI potential, and secondly, by the fact that the HEI activity profile was quite modern. According to this conditional group, NSMTU is in the 2nd place. According to the ratio of income from economic contracts to the number of teaching staff ($EFF_{15.1}$) in all years, except 2019, the number of patents for inventions, utility models, industrial designs, and selection achievements received was for professors and selection achievements. teachers and by the indicator ($EFF_{13.1}$) has been leading for the last 4 years.



| | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|
| BETI | 100,57 | 87,84 | 204,06 | 240,39 | 364,98 | 289,19 |
| BIMNR | 248,94 | 193,28 | 215,22 | 208,34 | 223,04 | 215,02 |
| SSUAC | 34,4 | 182,04 | 29,81 | 46,85 | 66,96 | 65,19 |
| TUITSamB | 220,82 | 457,47 | 370,46 | 336,03 | 358,54 | 355,94 |
| NSMTU | 200,68 | 182,06 | 265,54 | 265,81 | 252,27 | 288,73 |

Figure 8: Dynamics of innovation efficiency indicators in technical universities of Zarafshan region.

## 5 CONCLUSIONS

The conducted research has served as a basis to draw the following main conclusions about the efficiency of research and innovation activity of technical HEIs in the region:

- the efficiency of scientific research and innovation activity is not the result of the availability of potential, but the result of its rational use;

- the proposed methodology for assessing the innovation activity of HEIs is designed primarily for the management and staff of HEIs that make managerial decisions aimed at the development of innovation activity. Also, we believe that the proposed methodology will be useful for a wide range of researchers who use the results of the assessment to study the nature of innovation activity of local universities and patterns of development;

- another important feature of the methodology is the possibility of comparing individual universities in terms of the level of innovation environment development both in general and by its individual components, including the possibility of comparing specific evaluation criteria. We believe that this allows us to identify "weaknesses" and reserves for the development of innovation activity of HEIs, and also contributes to the improvement of their competitiveness and positions in national and world rankings;

One of the drawbacks of the methodology is that it is pointless to find a standard indicator until the relevant indicators of all subjects are determined. the proposed criteria, in our opinion, adequately describe the conditions for the effective development of innovation activity formed in HEIs, and we believe that their systematic application provides an adequate assessment of the innovation environment.

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