PhD THESIS

RESEARCH ON THE DEVELOPMENT OF A HIERARCHY SYSTEM FOR HIGHER EDUCATION INSTITUTIONS

SUMMARY

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Bucharest

2022

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List of Abbreviations

AHP	Analytical Hierarchy Process
AI	Artificial Intelligence
AR	Augmented Reality
ARWU	Academic Ranking of World Universities
CWCU	Center for World-Class Universities
CWTS	Centre for Science and Technology Studies (Centrum voor Wetenschaps - en Technologiestudies)
CWUR	Center for World University Ranking
ECTS	European Credit Transfer System
ENQA	European Association for Quality Assurance in Higher Education
ESG	European Standards and Guidelines
ESG	European Standards and Guidelines for Quality Assurance in Higher education
HEI	Higher Education Institution
HESA	Higher Education Statistics Agency
IREG	International Ranking Expert Group.
ISBN	International Standard Book Number, un cod internațional de identificare a cărților
ISSN	International Standard Serial Number, un cod internațional de identificare a publicațiilor seriale
JCR	Journal Citation Reports
MBA	Master of Business Administration
ME	Ministry of Education
NCFHE	National Council for the Financing of Higher Education
NTU	National Taiwan University
QS	Quacquarelli Symonds
QS WUR	QS World University Ranking
RAQAHE	Romanian Agency for Quality Assurance in Higher Education
SCI	Science Citation Index
SSCI	Social Science Citation Index
THE WUR	Times Higher Education World University Ranking
U-MRK	U-Multirank
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNESCO-CEPES	UNESCO European Centre for Higher Education
URAP	University Ranking by Academic Performance
URL	Uniform Resource Locator
USA	Unites States of America
US News	US News and Report Ranking
VR	Virtual Reality (Realitate virtuală)
WoS	Web of Science

Abstract

The topic of the doctoral thesis was chosen following the observation that, recently, most international university rankings are increasing their impact and importance. Considering their diversity in terms of origins, purposes and procedures used, we consider it necessary to deepen the knowledge and understanding of the mechanisms behind these rankings, clearly defining and comparing them in terms of the indicators and criteria used. The thesis aims to develop an original ranking methodology, based on objective criteria, adapted to the concrete reality of the higher education system in our country. The paper addresses this theme, aiming at a clear and transparent perspective of both the information managed by these rankings and the respective processes of capturing, processing and publishing their results.

Students from Romania frequently win leading places at international Olympiads, and at the end of high school, many of our Olympians choose to study at universities abroad, better rated in international rankings, than Romanian universities. How can this exodus be stopped?

How can we have universities located at the top of these rankings? Quality and performance are important in all aspects of life, but in the higher education sector they make a difference. In this sense, a main objective of Romanian universities is to improve their position in international rankings. International rankings help higher education institutions build a favorable global image and enable them to compete internationally. At the national level, two rankings of Romanian universities have been made so far:

- Ad Astra – Top of Romanian Universities – Ranking by fields – 2020 (national);
- Kienbanm Management Consultants in collaboration with Capital magazine (national).

Despite these attempts, currently in Romania there is no HEI ranking recognized by the Ministry of Education. The thesis aims to fill this gap by identifying the best practices that would allow the preparation of a HEI ranking, recognized by the ministries, and the development of some recommendations regarding the actions to be followed for Romanian higher education institutions to occupy better places in the international rankings.

The work is based on the AHP methodology, which is developed in a process containing 5 stages. In the first stage, a detailed research of the literature was carried out to identify all the indicators that are used in nine international rankings analyzed in the paper. In the second stage, the identified indicators were evaluated to determine the importance of each one, thus resulting in the most important indicators that are frequently used by international rankings. In the third stage, the AHP technique was used to calculate the weights of the most important indicators used, after a description of each chosen indicator was previously made. Finally, a framework for evaluating the degree of use was proposed, in order to rank the indicators in the international rankings. The last stage concerns the results of the research, namely the establishment of 3 work scenarios and the weights of each indicator separately, presented in a dedicated application.

The results of the analysis allow, on the one hand, the drawing up of a methodology/metrics for the classification of higher education institutions in Romania, recognized by the Ministry of Education and, on the other hand, facilitating the access of higher education institutions in Romania to international rankings.

Introduction

The world of higher education is becoming increasingly complex, with an increasing number of universities and education providers competing in a global market. In an increasingly internationalized and globally connected scenario, the higher education arena is becoming increasingly competitive, with universities under constant pressure to secure their student numbers, strengthen or improve their reputation, and provide research funding. In such a complex environment, there are emerging tools that aim to represent the prestige and reputation of universities in general in terms of perceived quality through qualitative and quantitative indicators. These tools include internal and external quality assurance processes and procedures, accreditation, assessment, benchmarking, accountability systems and national or global university rankings, the latter being the subject of this thesis.

The topicality of the research theme is evident from this effervescence of universities to occupy a leading place in the rankings and to attract more students, therefore more money. While some higher education institutions strive to improve their position, others simply want to be included in various international rankings, as the ranking is equivalent to being visible to potential students, higher education partners, policy makers, mass media etc.

The issue of the evaluation of higher education institutions can be addressed at different levels, from the level of the institution to the level of specializations or courses. Defining criteria and indicators for different situations/contexts (or any possible variation thereof) is a highly sensitive issue, so each HEI ranking must clearly state its target context. In this study, we focus on the evaluation of higher education institutions starting from three key differentiators, thus offering three variants of evaluation.

The first chapter is presented in the form of a critical analysis of the ways of classifying and ranking educational institutions at the international level, followed by a centralization of the indicators from the selected international rankings. To these 9 rankings is added the critical analysis of the European U-multirank ranking.

The second chapter focuses on the structure of the higher education system in Romania and classifications of Romanian universities at national and international level. The chapter begins with the analysis of the role held by: the Ministry of Education (ME), the Romanian Agency for Quality Assurance in Higher Education (RAQAHE) and the National Council for the Financing of Higher Education (NCFHE) in the regulation of higher education institutions in Romania, followed by the critical analysis of the proposed methodologies in order to classify Romanian universities.

The third chapter introduces the research methodology, namely the AHP - Analytical Hierarchy Process methodology, the stages of the research and the stages followed in order to establish the relevant indicators for ranking.

In the 4ᵗʰ chapter, Development of an online platform/application for the calculation of indicators, the online platform/application is presented, both in structure and functionality, and in *the 5ᵗʰ chapter*, the loading mode of the data in the proposed application, as well as the results obtained, depending on the work option chosen.

In the last chapter, *Chapter 6. Conclusions and proposals*, the conclusions of the paper, original contributions, future research directions and proposals for improving the visibility of higher education institutions in Romania are summarized.

PART I
THE CURRENT STATE REGARDING UNIVERSITY RANKINGS

Part I. The current state regarding university rankings

Chapter 1. International rankings

The chapter presents the link between the quality assurance process and international classification and ranking systems, as perceived by international education specialists.

1.1. Short history

Global university rankings have become increasingly important "computing devices" for assessing the quality of higher education and research [H01]. From a historical point of view, the mathematician Carl (Karel) Kořistka publishes, in **1863** in Gotha, Germany, the article "Der höhere polytechnische Unterricht in Deutschland, der Schweiz, in Frankreich, Belgien und England", in which he compares the polytechnic institutions of higher education from 5 countries: Germany, Switzerland, France, Belgium and England [K08].

In parallel, more and more such rankings are beginning to appear in the US: in the 1870s, the Bureau of Education classified educational institutions into four classes; in **1903**, Edwin G. Dexter classified, but did not rank, institutions based on excellent graduates [D09]; in **1906** (**1910**) James Cattel published "The American Man of Science" in which he described the demographics of thousands of scientists based on scientific merit [S13].

His model was used in the first systematic quantitative studies of science. Cattell used two concepts for his statistics: productivity, defined as the number of scientists a nation produces, but also performance and merit, defined as scientific contribution to research. These are the two dimensions that still define the measurement of scientific productivity today: quantity and quality [G01].

A year later, in **1983**, the US News and Report Ranking appeared, as well as the ranking of the MBA program in the Business Week MBA, with the listing of MBA programs, being the first modern ranking system of universities, published every year since then, and in 1986 the US News and Report US Colleges Ranking appeared.

At the global level, the rankings appear in the period 1999-2000, with the publication of the best universities in Asia - Time Asiaweek - Asia's Best universities and in the period 1999-2001, the University of Shanghai publishes the higher education programs. In **2003**, the Academic Ranking of World Universities (ARWU) appeared, which represents the most well-known and most elitist such ranking, currently.

In **2004**, the Times Higher Education Supplement (THES) - QS World University Rankings appeared. The QS World University Rankings is the ranking of the best universities in the world. It is provided by Quacquarelli Symonds and has been published annually since 2004 [B04]. In **2007**, Taiwan made a ranking of the performance of scientific papers of universities around the world (Performance Ranking of Scientific Papers for World Universities - NTU Ranking) [K05]. In Leiden, the Netherlands, the first educational ranking appears from the Center for Science and Technology Studies (CWTS), and in Paris, France, an international professional classification of higher education institutions (International Professional Classification of Higher Education Institutions - Mines) is carried out. In **2008**, the Report appeared world SCImago (SCImago World Report), also known as Scopus, being a resource by which research-focused institutions and universities are evaluated, from a scientific point of view, worldwide. Immediately, one year later, the SCImago Institutions Ranking [T06] also appears.

In **2009**, the University Ranking by Academic Performance (URAP) from Turkey appeared [D13]. In **2010**, two rankings of universities around the world appeared (Times

Higher Education World University Ranking – Thomson Reuters and QS World University Ranking). In 2014, U-Multirank was officially launched at an EU Presidency conference in Ireland [U01].

For over a decade, global university rankings have played an important role in increasing status competitiveness in higher education. Ranking as high as possible in international rankings has become a target for both universities and their national education systems. Thus, most universities try to adapt to the existing hierarchies.

1.2. Critical analysis of the ways of classifying and ranking universities at the international level

In what follows, 9 of the above-mentioned rankings, the most well-known, with significant relevance, will be analyzed.

1.2.1. US News and Report Ranking

About 30 years ago, US News began ranking universities in the United States, but in recent years it has begun to expand globally. In this ranking, the indicators are divided into 3 categories, depending on their type, as follows [F01]:
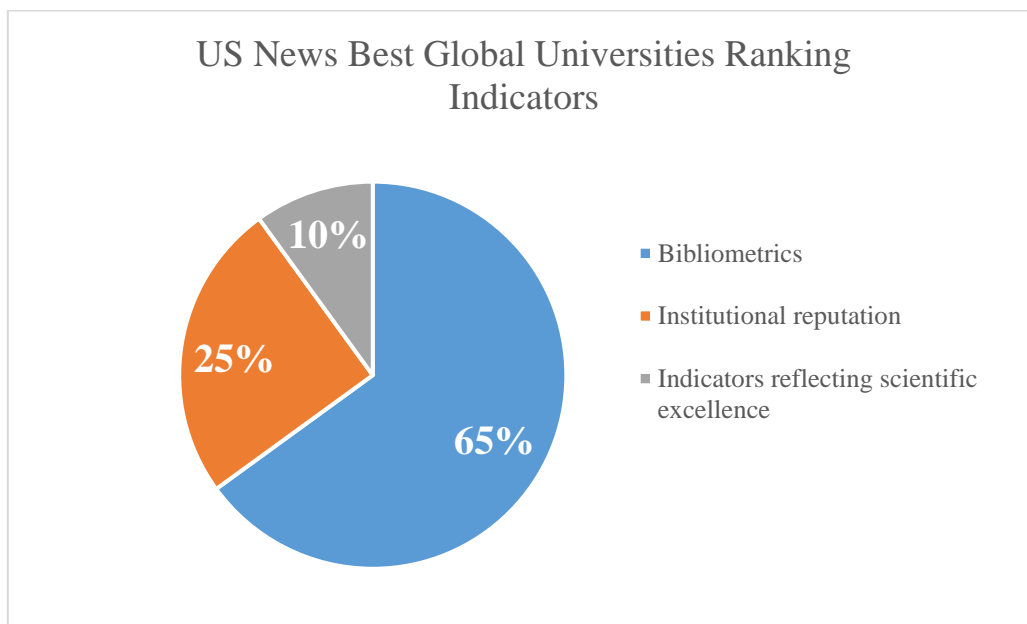
Fig. 1.1. US News and Report Ranking Indicators [U6]

1. Bibliometrics (65%):
    a. Publications in the most cited journals (19.23%);
    b. Publications in prestigious magazines (15.38%);
    c. Impact factor of citations in Clarivate Analytics (15.38%);
    d. Percentage of publications in the most cited journals (15.38%);
    e. International collaborations (15.38%)
    f. Total citations (11.54%);
    g. Edited volumes (3.85%);
2. Institutional reputation (25%):

    a.   Global reputation regarding the research carried out (50%);

    b.   Reputation at the regional level regarding the research carried out (50%).

3.   Indicators reflecting scientific excellence (10%)

    a.   Scientific excellence (100%).

According to the US News and Report Ranking, the global ranking of institutions at the end of 2020 is as follows:

Tab. 1.1. The ranking of universities according to US News and Report Ranking

Number	*Institution name*	*Country*	*Global score*
1.	Harvard University	United States of America	100
2.	Massachusetts Institute of Technology	United States of America	97,9
3.	Stanford University	United States of America	95,3
4.	University of California – Berkeley	United States of America	89,8
5.	University of Oxford	Great Britain	87
6.	Columbia University	United States of America	86,7
7.	California Institute of Technology	United States of America	86,3
8.	University of Washington	United States of America	86
9.	University of Cambridge	Great Britain	85,8
10.	Johns Hopkins University	United States of America	85,1

Source: US News and Report Ranking, (2021). 2021 Best Global Universities Rankings, Applicable to: https://www.usnews.com/education/best-global-universities/rankings?int=top_nav_Global_Universities, accessed on 15.03.2021

1.2.2. Academic Ranking of World Universities - ARWU

The ARWU ranking compared 1,800 higher education institutions worldwide and ranked the first 1,000 higher education institutions in the year 2020. The indicators tracked by those who compile this top refer to:

1.   Quality of education (40%):

    a.   Teaching staff with Nobel or Fields prizes (50%);

    b.   Total citations (50%);
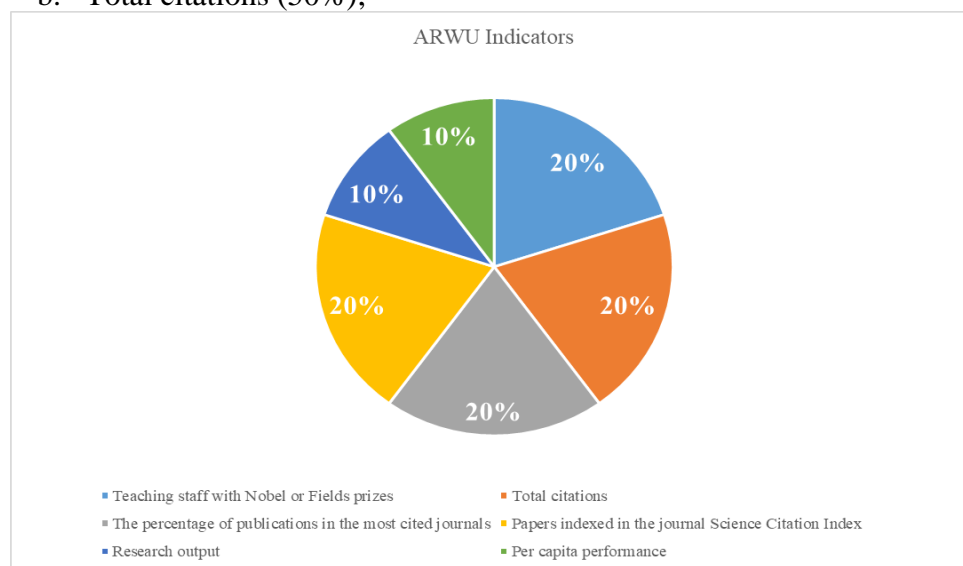
Fig. 1.2. ARWU Indicators [A07]

2. Quality of Faculty (40%):
    a. The percentage of publications in the most cited journals (50%);
    b. Papers indexed in the journal Science Citation Index (50%);
3. Research output (100%);
4. Per capita performance (100%).

According to ARWU, the ranking of institutions globally at the end of 2020 is as follows:

Tab. 1.2. The ranking of universities according to ARWU

Number	*Institution name*	*Country*	*Global score*
1.	Harvard University	United States of America	100.0
2.	Stanford University	United States of America	74.2
3.	University of Cambridge	Great Britain	70.6
4.	Massachusetts Institute of Technology	United States of America	69.6
5.	University of California – Berkeley	United States of America	65.8
6.	Princeton University	United States of America	61.1
7.	Columbia University	United States of America	58.6
8.	California Institute of Technology	United States of America	57.7
9.	University of Oxford	Great Britain	57.2
10.	University of Chicago	United States of America	54.6

Source: ARWU (2020). Academic Ranking of World Universities 2020, Available at:
http://www.shanghairanking.com/ARWU2020.html, accessed on 15.03.2021

1.2.3. CWTS Leiden Ranking

The CWTS Leiden Ranking provides a sophisticated set of bibliometric indicators, all of equal weight (25%), which provide university-level statistics on (CWTS, 2020a) (Fig. 1.13):
    a. Scientific impact indicators (25%);
    b. Collaboration indicators (25%);
    c. Open access indicators (25%);
    d. Gender indicators (25%).

Fig. 1.3. CWTS Indicators [F05]

According to CWTS, the global ranking of institutions at the end of 2020 is as follows:

Tab. 1.3. The ranking of universities according to CWTS

Number	Institution name	Country	Global score
1.	Harvard University	United States of America	33722
2.	Shanghai Jiao Tong University	China	24180
3.	Zhejiang University	China	23510
4.	University of Toronto	Canada	22995
5.	Tsinghua University	China	19902
6.	University of Michigan	United States of America	18598
7.	University of São Paulo	Brazil	17885
8.	Peking University	China	17285
9.	Johns Hopkins University	United States of America	17215
10.	Seoul National University	South Korea	16581

Source: CWTS (2020b). Leiden Ranking 2020. Available at:
https://www.leidenranking.com/ranking/2020/list, accessed on 15.03.2021

1.2.4. Performance Ranking of Scientific Papers of World Universities – NTU – Ranking

The ranking of scientific work performance of universities around the world is hosted by Dr. Mu-Hsuan Huang, professor of National Taiwan University. Its indicators together represent three different criteria of scientific work performance: research productivity, research impact and research excellence, as follows:

1. Research productivity (25%), which is described by 2 other indicators:
   a. Total articles (40%);
   b. Articles in the current year (60%).
2. Research impact (35%), composed of 3 indicators:
   a. Total citations (42.86%);
   b. Citations in 2 years (28.57%);
   c. Average of citations (28.57%).
3. Excellence in research (40%), described by 3 indicators:
   a. Impact of citations (28.57%);
   b. Scientific excellence (42.86%);
   c. Publications in the most cited journals (42.86%).
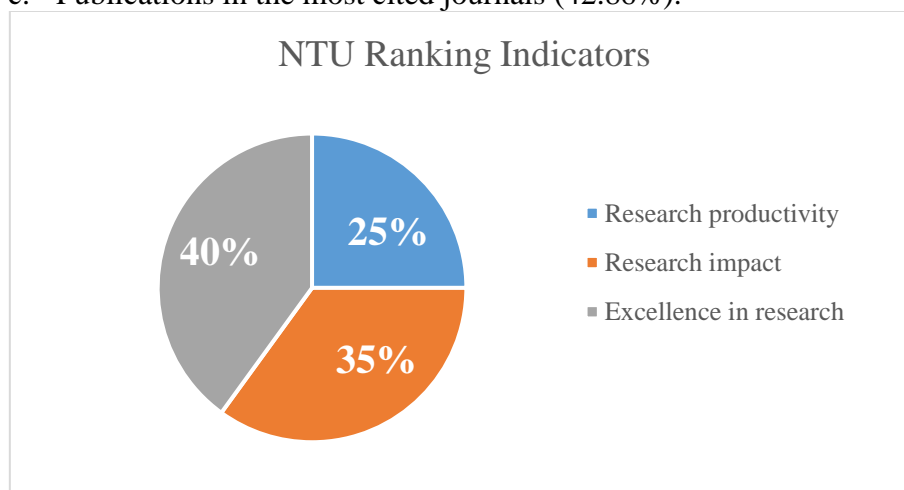
Fig. 1.4. Indicatorii NTU Ranking Indicators [N04]

According to NTU Ranking, the global ranking of institutions at the end of 2020 is as follows:

Tab. 1.4. The ranking of universities according to NTU Ranking

Number	Institution name	Country	Global score
1.	Harvard University	United States of America	98,6
2.	Stanford University	United States of America	65,7
3.	University of Toronto	Canada	62,2
4.	Johns Hopkins University	United States of America	61,3
5.	University College London	Great Britain	61,2
6.	University of Oxford	Great Britain	60,9
7.	Massachusetts Institute of Technology	United States of America	59,9
8.	University of Washington	United States of America	58,8
9.	University of Michigan	United States of America	57,7
10.	University of Pennsylvania	United States of America	56,8

Source: NTU Ranking (2020b). Available at: http://nturanking.csti.tw/ranking/OverallRanking/,
accessed on 16.03.2021

1.2.5. SCImago Institutions Rankings

The SCImago Institution Ranking is a scientific assessment resource to assess research-focused institutions and universities worldwide. Academic and research-related institutions are indicator classifications that combine 3 different sets of indicators based on research performance, innovation results and social impact, as follows:

1. Research (50%):
    a. Impact of citations (26%);
    b. Excellence in leadership (16%);
    c. Articles in Scopus (16%);
    d. Scientific leadership (10%);
    e. Articles in own magazines (6%);
    f. Owned magazines (6%);
    g. International collaborations (4%);
    h. Publications in the most cited journals (4%);
    i. Scientific excellence (4%);
    j. Open access publishing (4%);
    k. Scientific Talent Pool (4%).
2. Innovation (30%):
    a. Patents (33.33%);
    b. Patents from a certain category (33.33%);
    c. Technological impact (33.33%).
3. Social impact (20%):
    a. Altmetrics (50%);
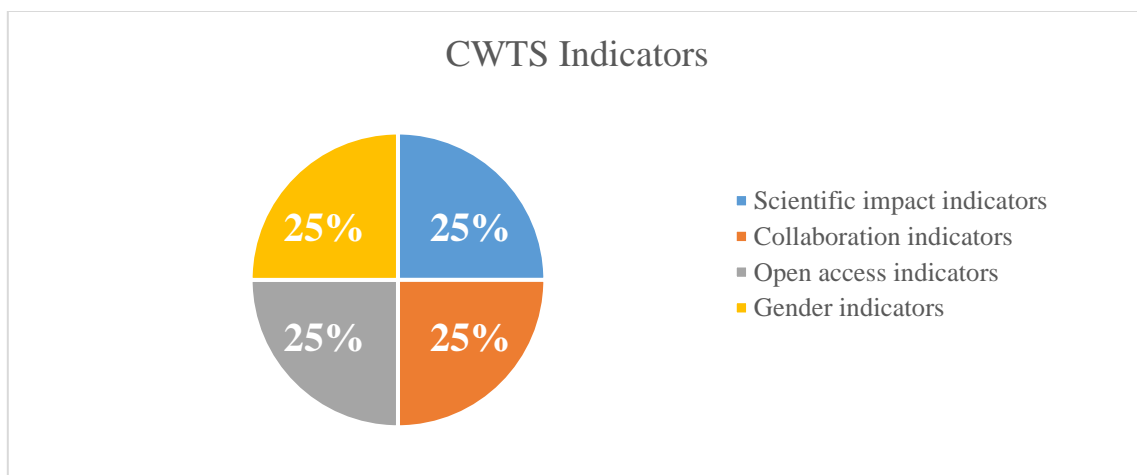   b. Links (25%);
    c. Web dimension (25%).
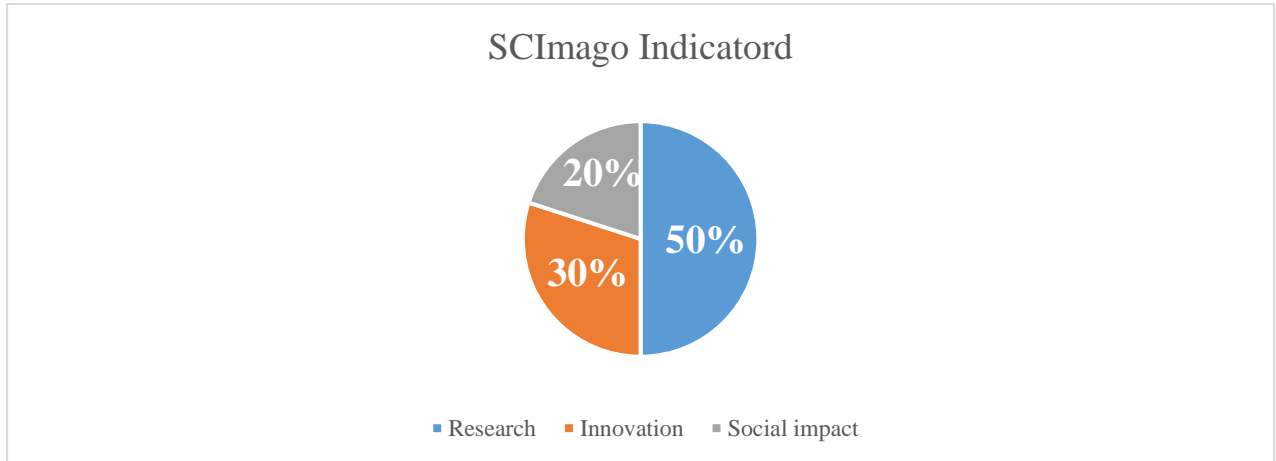
Fig. 1.5. SCImago Indicators [Q05]

According to SCImago, the global ranking of institutions at the end of 2020 is as follows:

Tab. 1.5. The ranking of universities according to SCImago

Number	Institution name	Country
1.	Harvard University	United States of America
2.	Harvard Medical School	United States of America
3.	Massachusetts Institute of Technology	United States of America
4.	Stanford University	United States of America
5.	Tsinghua University	China
6.	University of Oxford	Great Britain
7.	Johns Hopkins University	United States of America
8.	University College London	Great Britain
9.	University of Washington	United States of America
10.	University of Michigan	United States of America

Source: SCImago Institutions Rankings (SIR). (2020b), Higher Education. Available at: https://www.scimagoir.com/rankings.php?sector=Higher%20educ., accessed on 16.03.2021.

1.2.6. University Ranking by Academic Performance – URAP

Another well-known system for ranking higher education institutions is University Ranking by Academic Performance (URAP). These indicators will be presented in the following:

1. Publications in the most cited journals (21%);
2. Publications in prestigious journals (21%);
3. Citation ratio (18%);
4. Weighted citation ratio (15%);
5. International collaborations (15%);
6. Presentations (10%).

As can be seen from Fig. 1.19, the URAP indicators are mostly of close weights: the highest weights are assigned to articles published and indexed in the most prestigious recent ones (with weights of 21%), followed by the indicators that refer to citations, at the global level (18%), but also on certain fields (15%). The international collaborations that a higher education institution/university has with other entities have a weight of 15%, and the presentations that

teaching staff make during conferences, seminars or other educational events have the lowest weight, of 10%.
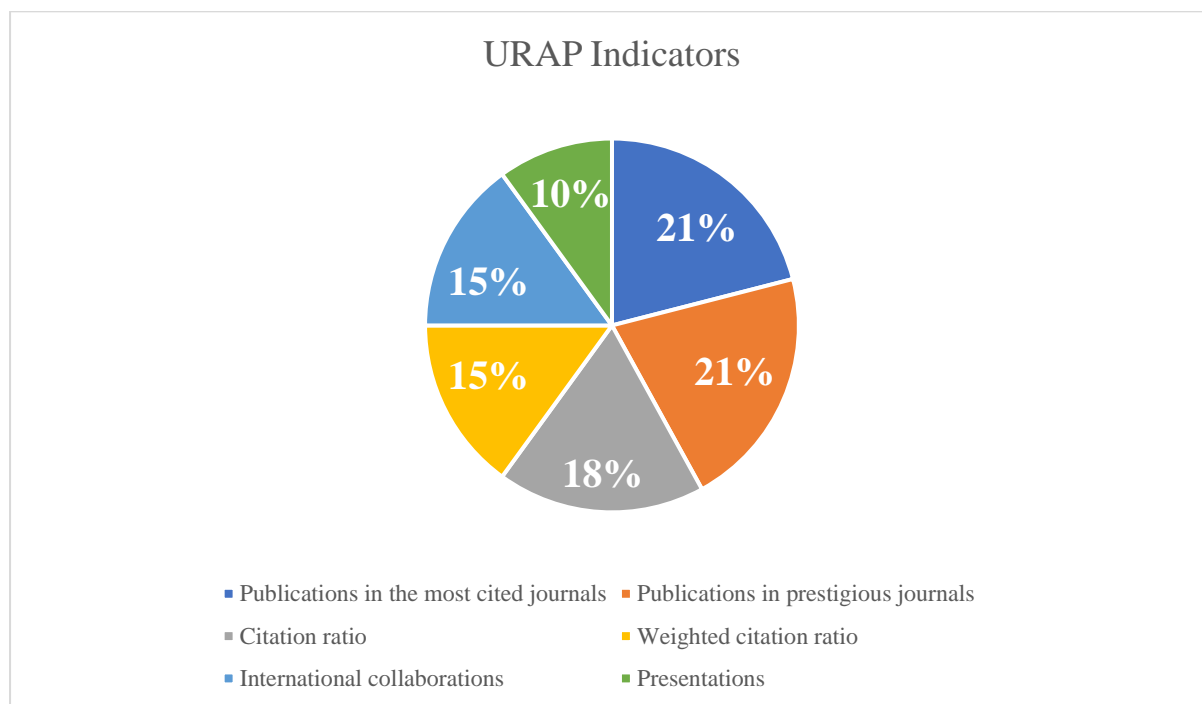
Fig. 1.6. URAP Indicators [U05]

According to URAP, the ranking of institutions at the global level at the end of 2020 is as follows:

Tab. 1.6. The ranking of universities according to URAP

Number	Institution name	Country	Global score
1.	Harvard University	United States of America	600
2.	University of Toronto	Canada	584,03
3.	Stanford University	United States of America	576,57
4.	University College London	Great Britain	576,49
5.	University of Oxford	Great Britain	574,21
6.	Johns Hopkins University	United States of America	565,45
7.	University of Cambridge	Great Britain	559,28
8.	University of Michigan	United States of America	556,51
9.	Paris-Saclay University	Franța	552,59
10.	University of Washington	United States of America	551,49

URAP, 2020b, Rankings. Available at: https://www.urapcenter.org/Rankings/2020-2021/World_Ranking_2020-2021, accessed on 16.03.2021.

1.2.7. QS World University Rankings

The QS World University Rankings is one of the classification and ranking systems that is audited and approved by the Observatory on Academic Ranking and Excellence (IREG), thus being one of the most well-known such systems. In order to achieve a hierarchy, the following indicators are taken into account (QS, 2021) (Fig. 1.7):

1. Academic reputation (40%);
2. Total citations (20%);
3. Staff/student ratio (20%);
4. Reputation of employers (10%);
5. Internationalization of the university (10%): of which 5% internationalization of students and 5% internationalization of faculties (5%).
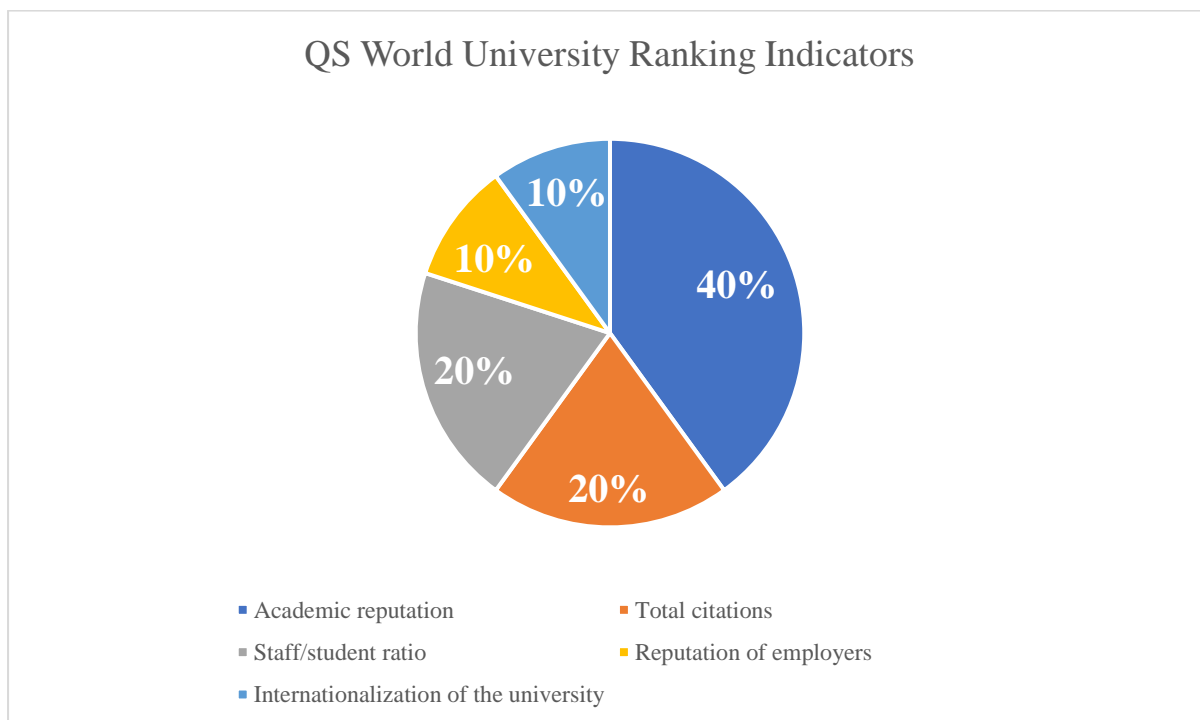
Fig. 1.7. QS World University Ranking Indicators [Q04]

According to the QS World University Ranking, the global ranking of institutions at the end of 2020 is as follows:

Tab. 1.7. The ranking of universities according to QS World University Ranking

Number	Institution name	Country	Global score
1.	Massachusetts Institute of Technology	United States of America	100
2.	Stanford University	United States of America	98,4
3.	Harvard University	United States of America	97,4
4.	University of Oxford	Great Britain	97,2
5.	California Institute of Technology	United States of America	96,9
6.	Swiss Federal Institute of Technology	Elveția	95,9
7.	University of Cambridge	Great Britain	95
8.	University College London	Great Britain	94,8
9.	Colegiul Imperial din Londra	Great Britain	94,1
10.	University of Chicago	United States of America	92

Source: QS, (2020), QS World University Rankings 2020, Available at https://www.qschina.cn/en/university-rankings/world-university-rankings/2020, accessed on 16.03.2021.

1.2.8. THE World University Rankings

The Times Higher Education World University Rankings is another tool for ranking higher education universities around the world. THE is audited by PriceWaterHouseCoopers and uses 13 indicators to rank universities worldwide, grouped by class (THE, 2021):

1. The learning process (30%), which tracks several indicators, such as:
    a. Academic reputation (50%);
    b. PhD students (20%);
    c. Personal report – students (15%);
    d. Ratio of undergraduate students – doctoral students (7.5);
    e. Income of the institution (7.5%).
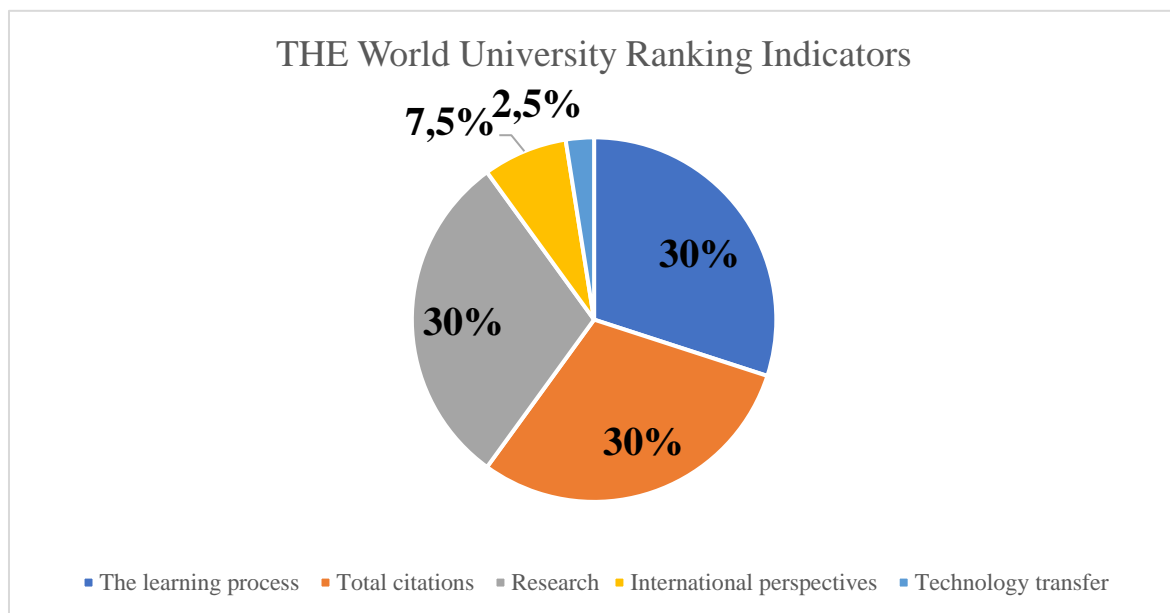
Fig. 1.8. THE World University Ranking Indicators [T01]

2. Total citations (30%);
3. Research (30%) – considers three indicators:
    a. Reputation at global level regarding the research carried out (60%);
    b. Income from research (20%);
    c. Articles in Scopus (20%);
4. International perspectives (7.5%) – consists of three other indicators, which have the same proportion, namely:
    a. Ratio of domestic students – foreign students (33.33%);
    b. Ratio of employees - foreign students (33.33%);
    c. International collaborations (33.33%);
5. Technology transfer (2.5%).

According to THE World University Ranking, the global ranking of institutions at the end of 2020 is as follows:

Tab. 1.8. The ranking of universities according to THE World University Ranking

Number	Institution name	Country	Global score
1.	University of Oxford	Great Britain	95,4
2.	California Institute of Technology	United States of America	94,5
3.	University of Cambridge	Great Britain	94,4
4.	Stanford University	United States of America	94,3
5.	Massachusetts Institute of Technology	United States of America	93,6
6.	Princeton University	United States of America	93,2
7.	Harvard University	United States of America	93
8.	Yale University	United States of America	91,7
9.	University of Chicago	United States of America	90,2
10.	Colegiul Imperial din Londra	Great Britain	89,8

Source: THE, (2020), World University Rankings 2020, Available at:
https://www.timeshighereducation.com/world-university-rankings/2020/world-
ranking#!/page/0/length/25/sort_by/rank/sort_order/asc/cols/scores, accessed on 15.03.2021

1.2.9. Center for World University Ranking – CWUR

When a classification is made, CWUR takes into account the quality of education and training of students, as well as the prestige that representatives of a university have through the quality of research carried out by them. CWUR uses 7 carefully selected indicators to rank universities around the world, namely:
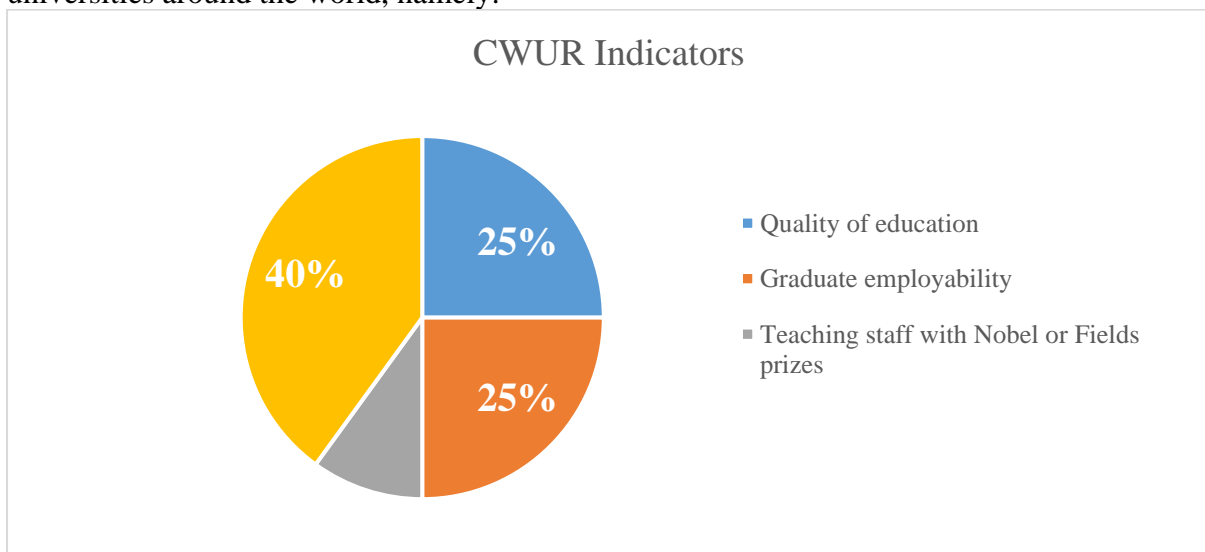
Fig. 1.9. CWUR Indicators[M08]

1. Quality of education (25%);
2. Graduate employability (25%);
3. Teaching staff with Nobel or Fields prizes (10%);
4. Research performance – described by 4 indicators, of equal weight (40%):

    a. Publications in prestigious journals (25%);
    b. Publications in the most cited journals (25%);
    c. Total citations (25%);
    d. Impact of citations (25%).

According to CWUR, the ranking of institutions at the global level at the beginning of 2021 is as follows:

Tab. 1.9. The ranking of universities according to CWUR

Number	Institution name	Country	Global score
1.	Harvard University	United States of America	100
2.	Massachusetts Institute of Technology	United States of America	96,7
3.	Stanford University	United States of America	95,2
4.	University of Cambridge	Great Britain	94,1
5.	University of Oxford	Great Britain	93,3
6.	Columbia University	United States of America	92,6
7.	Princeton University	United States of America	92
8.	University of Pennsylvania	United States of America	91,6
9.	University of Chicago	United States of America	91,1
10.	Yale University	United States of America	90,7

Source: CWUR (2021b). World University Rankings 2020-21, Available at: https://cwur.org/2020-21.php, accessed on16.03.2021.

1.3. The centralization of indicators from international rankings

Considering the large and varied number of indicators identified in the 9 international rankings, they will be centralized according to the following table:

Tab. 1.10. The centralization of international indicators

No.	Indicator name	International ranking									
		US News	ARWU	CWTS	NTU	SCImago	URAP	QS WUR	THE WUR	CWUR	Mentions
1.	Publications in the most cited journals	12,5%	-	25%	15%	2%	21%	-	-	10%	6 (85,5%)
2.	Publications in prestigious journals	10%	-	-	-	-	21%	-	-	10%	2 (31%)
3.	Citation Impact Factor in Clarivate Analytics	10%	-	-	-	-	-	-	-	-	1 (10%)
4.	Percentage of publications in the most cited journals	10%	20%	-	-	-	-	-	-	-	2 (30%)
5.	International collaborations	10%	-	25%	-	2%	15%	-	2,5%	-	5 (54,5%)
6.	Total citations	7,5%	20%	-	15%	-	-	20%	30%	10%	6 (102,5%)
7.	Edited volumes	2,5%	-	-	-	-	-	-	-	-	1 (2,5%)
8.	conference	2,5%	-	-	-	-	-	-	-	-	1 (2,5%)
9.	Global reputation for research conducted	12,5%	-	-	-	-	-	-	6%	-	2 (18,5%)
10.	Regional reputation for research conducted	12,5%	-	-	-	-	-	-	-	-	1 (12,5%)
11.	Scientific excellence	10%	-	-	15%	2%	-	-	-	-	3 (27%)
12.	Teachers with Nobel or Fields prizes	-	20%	-	-	-	-	-	-	10%	2 (30%)
13.	Papers indexed in the journal Science Citation Index	-	20%	-	-	-	-	-	-	-	1 (20%)
14.	Quality of education	-	10%	-	-	-	-	-	-	25%	2 (35%)
15.	Academic performance	-	10%	-	-	-	-	-	-	-	1 (10%)
16.	Open access publication	-	-	25%	-	2%	-	-	-	-	2 (27%)
17.	Gender diversity	-	-	25%	-	-	-	-	-	-	1 (25%)

No.	Indicator name	International ranking									
		US News	ARWU	CWTS	NTU	SCImago	URAP	QS WUR	THE WUR	CWUR	Mentions
18.	Impact of citations	-	-	-	10%	13%	-	-	-	10%	3 (33%)
19.	Excellence in leadership	-	-	-	-	8%	-	-	-	-	1 (8%)
20.	Articles in Scopus	-	-	-	-	8%	-	-	6%	-	2 (14%)
21.	Scientific leadership	-	-	-	-	5%	-	-	-	-	1 (5%)
22.	Articles in own journals	-	-	-	-	3%	-	-	-	-	1 (3%)
23.	Own magazines	-	-	-	-	3%	-	-	-	-	1 (3%)
24.	Scientific talent pool	-	-	-	-	2%	-	-	-	-	1 (2%)
25.	PATENTS	-	-	-	-	10%	-	-	-	-	1 (10%)
26.	Patents in a specific category	-	-	-	-	10%	-	-	-	-	1 (10%)
27.	Technological impact	-	-	-	-	10%	-	-	-	-	1 (10%)
28.	Altmetrics	-	-	-	-	10%	-	-	-	-	1 (10%)
29.	Links	-	-	-	-	5%	-	-	-	-	1 (5%)
30.	Web size	-	-	-	-	5%	-	-	-	-	1 (5%)
31.	Citations report	-	-	-	-	-	18%	-	-	-	1 (18%)
32.	Weighted citation ratio	-	-	-	-	-	15%	-	-	-	1 (15%)
33.	presentation	-	-	-	-	-	10%	-	-	-	1 (10%)
34.	Academic reputation	-	-	-	-	-	-	40%	15%	-	2 (55%)
35.	Personal report - students	-	-	-	-	-	-	20%	4,5%	-	2 (24,5%)
36.	Reputation with employers	-	-	-	-	-	-	10%	-	-	1 (10%)
37.	Internationalization of the university	-	-	-	-	-	-	10%	-	-	1 (10%)
38.	Doctoral	-	-	-	-	-	-	-	6%	-	1 (6%)
39.	Bachelor's - PhD student ratio	-	-	-	-	-	-	-	2,25	-	1 (2,25%)
40.	Income of the institution	-	-	-	-	-	-	-	2,25	-	1 (2,25%)
41.	Research revenue	-	-	-	-	-	-	-	6%	-	1 (6%)
42.	Domestic students - foreign students ratio	-	-	-	-	-	-	-	2,5	-	1 (2,5%)
43.	Employees - foreign students ratio	-	-	-	-	-	-	-	2,5	-	1 (2,5%)
44.	Technological transfer	-	-	-	-	-	-	-	2,5	-	1 (2,5%)

No.	Indicator name	International ranking									
		US News	ARWU	CWTS	NTU	SCImago	URAP	QS WUR	THE WUR	CWUR	Mentions
45.	Graduate employability	-	-	-	-	-	-	-	-	25%	1 (25%)
46.	Total items	-	-	-	10%	-	-	-	-	-	1 (10%)
47.	Articles in the current year	-	-	-	15%	-	-	-	-	-	1 (15%)
48.	Citations in 2 years	-	-	-	10%	-	-	-	-	-	1 (10%)
49.	Average of citations	-	-	-	10%	-	-	-	-	-	1 (10%)

Considering the indicators mentioned above, a centralization of the 10 best ranked universities/institutions from the 9 analyzed rankings will be made (Tab. 1.11.):

Tab. 1.11 The centralization of the most prestigious universities

No.	University/Institution name	International ranking									
		US News	ARWU	CWTS	NTU	SCImago	URAP	QS WUR	THE WUR	CWUR	Mentions
1.	**Harvard University**	1	1	1	1	1	1	3	7	1	**9**
2.	**Massachusetts Institute of Technology**	2	4	>10	7	3	>10	1	5	2	**7**
3.	**Stanford University**	3	2	>10	2	4	3	2	4	3	**8**
4.	**University California – Berkeley**	4	5	>10	>10	>10	>10	>10	>10	>10	**2**
5.	**University of Oxford**	5	9	>10	6	6	5	4	1	5	**8**
6.	**California Institute of Technology**	7	8	>10	>10	>10	>10	5	2	>10	**4**
7.	**Columbia University**	6	7	>10	>10	>10	>10	>10	>10	6	**3**
8.	**Princeton University**	>10	6	>10	>10	>10	>10	>10	6	7	**3**
9.	**University of Cambridge**	9	3	>10	10	>10	7	7	3	4	**7**
10.	**University of Washington**	8	>10	>10	8	9	10	>10	>10	>10	**4**
11.	**University of Chicago**	>10	10	>10	>10	>10	>10	10	9	9	**2**
12.	**Shanghai Jiao Tong University**	>10	>10	2	>10	>10	>10	>10	>10	>10	**1**

13.	**University of Toronto**	>10	>10	4	3	>10	2	>10	>10	>10	**3**
14.	**Zhejiang University**	>10	>10	3	>10	>10	>10	>10	>10	>10	**1**
15.	**Tsinghua University**	>10	>10	5	>10	5	>10	>10	>10	>10	**2**
16.	**University of Michigan**	>10	>10	6	9	10	8	>10	>10	>10	**4**
17.	**Johns Hopkins University**	10	>10	9	4	7	6	>10	>10	>10	**5**
18.	**University of São Paulo**	>10	>10	7	>10	>10	>10	>10	>10	>10	**1**
19.	**Peking University**	>10	>10	8	>10	>10	>10	>10	>10	>10	**1**
20.	**Seoul National University**	>10	>10	10	>10	>10	>10	>10	>10	>10	**1**
21.	**Harvard Medical School**	>10	>10	>10	>10	2	>10	>10	>10	>10	**1**
22.	**University College London**	>10	>10	>10	5	8	4	8	>10	>10	**4**
23	**Swiss Federal Institute of Technology**	>10	>10	>10	>10	>10	>10	6	>10	>10	**1**
24	**Colegiul Imperial din Londra**	>10	>10	>10	>10	>10	>10	9	10	>10	**2**
25	**Yale University**	>10	>10	>10	>10	>10	>10	>10	8	10	**2**
26	**University of Pennsylvania**	>10	>10	>10	10	>10	>10	>10	>10	8	**2**
27	**Paris-Saclay University**	>10	>10	>10	>10	>10	9	>10	>10	>10	**1**

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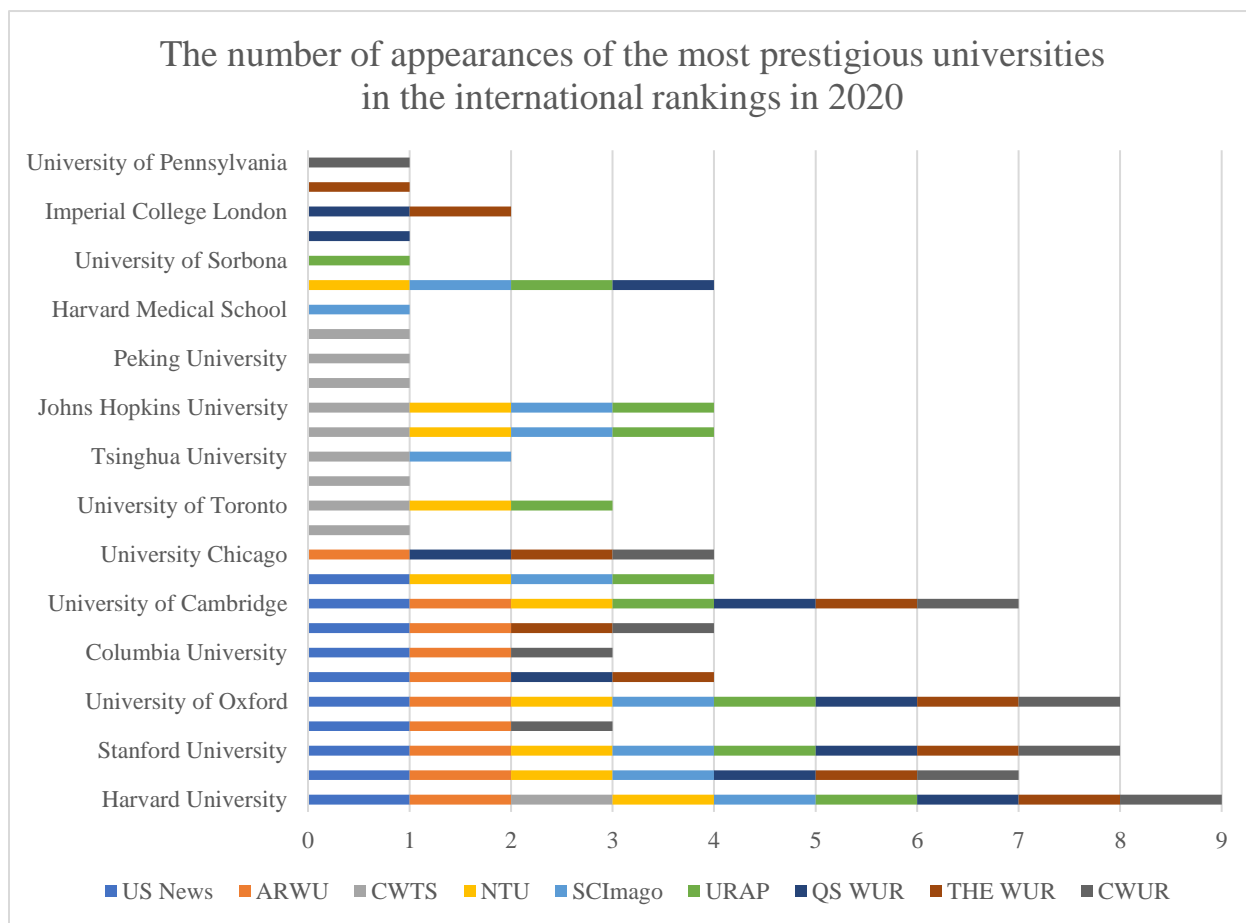
Fig. 1.10. The number of appearances of the most prestigious universities in the international rankings in 2020

As can be seen from the figure above, Harvard University from United States of America is by far the most prestigious university in the world, by the end of 2020 being in all 9 international rankings analyzed. In 7 of the 9 international rankings, the score regarding the indicators was maximum and in one of them close to the maximum (3rd place). The next most prestigious universities are Stanford University from United States of America and the University of Oxford from Great Britain.

1.4 European U-multirank ranking

The European Commission initiated the complex system of classification and ranking of higher education institutions. U-multirank represents "a multidimensional, user-oriented approach to the international ranking of higher education institutions" (U-multirank, 2021).

It can be observed that the ranking and ranking performed by U-multirank does not propose a general ranking (Fig. 1.28), but the ranking and ranking can be done as follows:
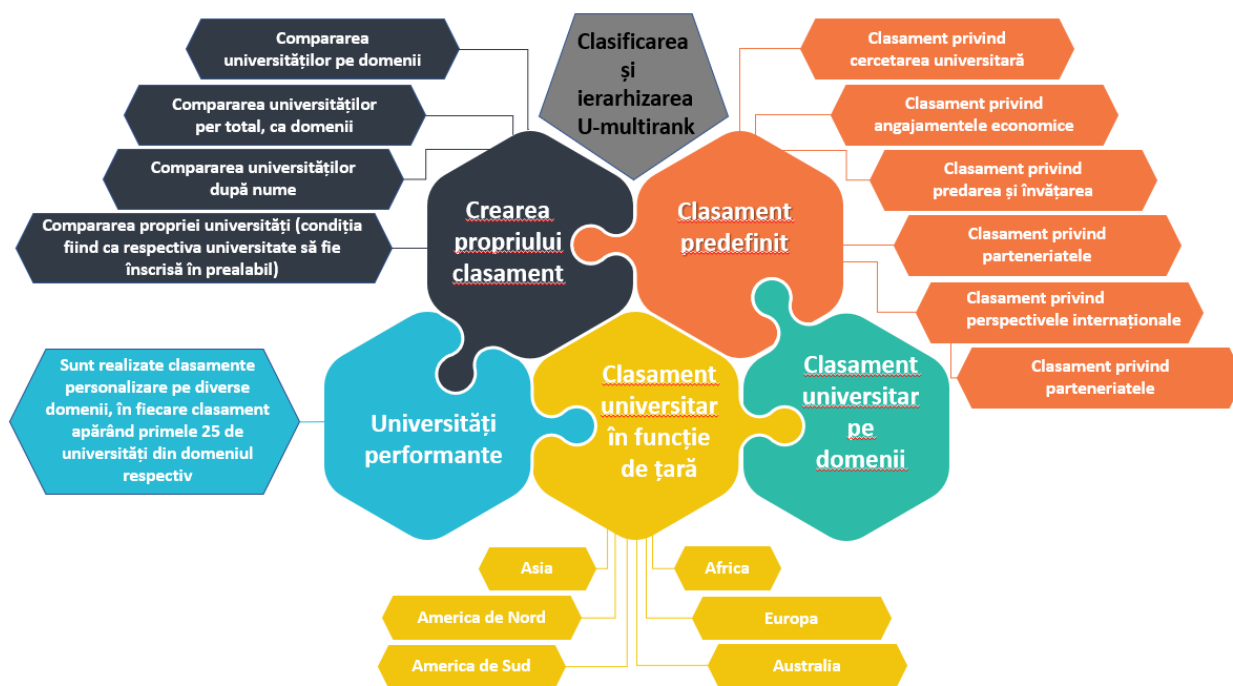
Fig. 1.11. U-multirank classification and ranking

At the beginning of 2019, 43 of the Romanian universities were included in the European U-multirank ranking, so that in 2020 their number will decrease to 40.

1.5. The analysis of organizational structure and legal regulations

The Ministry of Education operates in accordance with: National Education Law no. 1/2011 (updated), Government Decision no. 369/01.04.2021 on the organization and operation of the Ministry of Education, as well as the Regulation on the organization and operation of the Ministry of Education and Research (2020) with subsequent amendments and additions (approved by ministerial order no. 5.546/11.09.2020 and the related annex).

Government Decision no. 369/1.04.2021 outlines aspects related to the organization and operation of the ME.

1.6. The regulation of higher education institutions in Romania

Art. 114 of the National Education Law no. 1 (LEN) regulates in para. (1) "the structure, functions in the didactic field, organization and operation of higher education in Romania". Art. 114, para. (2) states that "higher education is organized in universities, study academies, institutes,

schools of higher studies and the like, hereinafter referred to as higher education institutions or universities".

Therefore, according to the National Education Law no. 1, in Romania, higher education institutions or universities that have obtained provisional operating authorization or accreditation are organized as universities, study academies, institutes or schools of higher education.

1.7. Conclusions

Faced with increasing competition among higher education institutions in domestic and global contexts, the number of national and international classification systems is increasing. Currently, university rankings are seen as a significant representation of improving academic excellence and institutional reputation.

The global ranking systems selected in this chapter are not perfect in measuring the institutional performance of higher education and in giving their ordinal statuses around the globe, there being, as could be seen, many criticisms and controversies. After analyzing the indicators' contributions to the final ranking of universities in the nine ranking systems, as well as in the European U-multirank ranking system, we can draw a number of conclusions. A first conclusion refers to the existence of a diversity in the evaluation method of a higher education institution in these international classification and ranking systems. Among all the proposed indicators, research is the only common point and each such system allocates a significant percentage to this indicator.

Another element that appears in these systems is the one that refers to internationalization, following the scientific connection between the university of analysis and another university in another state. Another observation is that these rankings (sometimes lacking altogether) do not track the teaching and learning dimension, often being considered only as perceptual indicators. The main finding is that U-Multirank is the only ranking with some relevant indicators, namely gender equity and community service learning.

At the same time, it can be said that most classification and ranking systems follow a certain branch of fields of study, which is related to the institutional evaluation of the country of which the university is a part, as it also happens in our country.

However, it can be said that the universities consider that a good positioning in these rankings brings with it a better visibility of a higher education institution at the international level (attraction of human, financial resources, etc.), but also the possibility to identify the state the university, its level of development in relation to universities around the world.

The existence of such a large number of classification and ranking systems shows the different visions that people from the academic environment have regarding the way and the purpose that these mechanisms have in achieving university rankings at the international level.

Therefore, taking into account the fact that all rankings use very different indicators and weightings to measure quality, we consider a more nuanced analysis of their relationship with the concept of quality in higher education and the process of its assurance necessary.

PART II

CONTRIBUTIONS TO THE DEVELOPMENT OF AN ORIGINAL UNIVERSITY CLASSIFICATION SYSTEM

Part II. Contributions to the development of an original university classification system

Chapter 2. The objectives of the doctoral thesis and research methodology

The objectives of the doctoral thesis

Driven by globalization and massification in higher education, university rankings have an increasing impact on all stakeholders. Similar to the pursuit of accountability and evaluation objectives, university rankings have become ubiquitous, both national ones, where they exist, but especially international ones. They are becoming more visible and more specialized, focusing, for example, on research performance or institutional reputation. In particular, the world university rankings, the subject of this paper, are considered by many as a means of representing academic excellence and increasing the prominence of higher education institutions, both locally and internationally.

The main objective of this doctoral thesis is the realization of an original ranking methodology, based on objective criteria adapted to the concrete reality of the higher education system in our country.

Also, the research focuses on two secondary objectives: the first objective is represented by the identification of those criteria and parameters that are desired in international standards. The second objective refers to the exploration of those practices that are considered the best in the international ranking system and the exploration of their adaptability, but also their existence in higher education institutions in Romania.

Today, rankings continue to grow in popularity and gain the interest of decision makers. Despite this aspect, there are several alarm signals expressed against them. Thus, the rankings have been subject to criticism regarding the measurement indicators and the diversity of the compared characteristics [L08].

The presented models allow comparisons of higher education institutions, based on the performance achieved and the quality of the analyzed processes. This solution allows higher education institutions to quantify the degree of achievement of the objectives set.

In addition, the 3 models allow the simulation and verification of different scenarios to improve the quality and performance of the methodology, which can have extremely positive effects on university governance and the improvement of higher education.

The originality of the research lies in the fact that the presented methodology and models can be made available to government institutions and can serve as a basis for the general ranking and evaluation of higher education institutions with the possibility of developing a performance-based financing system. In addition, other involved stakeholders may have an insight into the performance of an institution for the sake of their own needs and goals, be it students, business or other stakeholders.

2.2. Research methodology

As previously presented, the doctoral thesis started with the establishment of an overview of what global university rankings entail. For this purpose, research papers taken from international public databases were analyzed. Most of the works were from recent years, but other relevant older

works were also considered. Also, during the achievements of the aspects that have a novelty character, in parallel, hierarchies made at both national and international level were evaluated.

The establishment of the working hypotheses was carried out together with the coordinating professor, but also with advice from the specialist professors of the university.

As a working methodology, the work is based on the AHP methodology, an objective method for evaluating the chosen indicators which is developed in a process containing a sequence of stages as follows:

- a detailed research of the literature will be carried out to identify all the indicators that are used in 9 international rankings; an overview of classification systems will be made, including their historical evolution, the use of rankings by different actors, indicators classification, merits and criticisms of different international classification systems. Criteria and parameter values will be extracted from their official websites;
- the identified indicators will be evaluated to determine the importance of each one, thus resulting in the most important indicators that are frequently used by international rankings; based on these data, the criteria and indicators of the 9 international rankings will be compared according to the weights assigned to the different categories of indicators and the data source used to rank the higher education institutions;
- for a more detailed and in-depth perspective on the way to quantify quality in higher education in our country, the methodology project of the Ministry of Education in order to classify Romanian universities, as well as the rankings of universities in Romania and the evaluation criteria on nationally and internationally level. Thus, an "radiography" of higher education institutions in Romania and the positions held by them in the Romanian rankings, but also in the international rankings in which our country has universities present, will be carried out, respectively:
    - Shanghai Ranking;
    - CWTS Leiden Ranking;
    - University Ranking by Academic Performance (URAP);
    - QS World University Rankings;
    - SCImago Rankings;
    - THE (THE World University Rankings);
    - Center for World University Ranking – CWUR.
- a short analysis will be carried out, for the period 2015/2016-2020/2021, in order to identify the dynamics of the total score of Romanian universities and, implicitly, the identification of those that are visible at the international level, thus included in the analyzed rankings;
- a series of conclusions will be drawn as a result of the centralization of the rankings of Romanian universities at national and international level, conclusions that will reveal whether the classification systems are distinct or not in terms of their proposed objectives, target groups, indicators and weights attributed to them. It will be determined whether or not Romanian universities are well placed in international rankings. In addition, it will be determined whether the Number of universities appearing in different global rankings has increased or not over the years, along with the increase in the Number of universities included in these university rankings;

- a framework for evaluating the degree of use of the indicators will be proposed, with the related weights, in order to rank the indicators in the international rankings;
- the AHP technique will be used to calculate the weights of the most important indicators used, after a description of each chosen indicator will be made beforehand; indicators that are duplicated or have a similar meaning will be removed; The AHP methodology used captures additional aspects of the university ranking methodologies and comes to complement the existing expertise in the research area, suggesting a high degree of measurement precision. For these reasons, the general quantitative and therefore objective aspect of the indicators makes this new methodology for the classification of universities both transparent, reliable and sound from a methodological point of view;
- the results of the research will be targeted, namely the establishment of 3 work scenarios and the weights of each indicator separately, presented which will be used in a dedicated online application;
- an online platform/application will be developed both for calculating the indicators, in the 3 proposed variants, but also for providing additional information on what the application itself offers, which is the methodology used in calculating the final totals, the universities will be presented and a "News" area will be created to bring added value through the educational information it presents;
- the working interface of the application will be presented, with all its functionalities;
- it will be shown how to complete the data within the application, in order to achieve the ranking itself;
- the method of completing the data in the online platform/application will be simulated, with real data of a state university in Romania;
- finally, the conclusions of the paper will be summarized and the original contributions will be presented, as well as future research directions and proposals for improving the visibility of higher education institutions in Romania.

2.3. Conclusions

Our overall objective is to identify characteristics that reflect particularities for classifying higher education institutions specifically. The specific objective consists in exploring those practices that are considered the best in the international ranking system and their adaptability and existence in Romanian universities. In this sense, the basis of the thesis is the Analytical Hierarchy Process (AHP) methodology, with two major objectives: the preparation of a methodology/metrics for the classification of Romanian universities recognized by the ME and facilitating the access of Romanian universities to international rankings. The work aims to improve quality standards and allow Romanian institutions to compete globally, securing positions in international rankings.

Chapter 3. Analysis of the structure of the higher education system in Romania and the classifications at the national and international level

3.1. Critical analysis of the proposed methodologies for the classification of Romanian universities

3.1.1 Methodology project of the Ministry of Education (ME) in order to classify Romanian universities

The Ministry of Education, through a report published on December 29, 2017, proposes a methodology project in order to classify all universities in Romania. It is a joint project between the ministry, the World Investment Bank and the Romanian Agency for Quality Assurance in Higher Education, in order to improve educational policies (ME, 2018).

The methodology is structured on three levels, as follows:

- by types of universities;
- on university classes;
- on the dimensions of the universities.

For level 1, it is proposed that each university has 5 descriptive indicators, namely: university mission, university size, location, registration code and university name.

For the second level, according to art. 193, para. (4) of the National Education Law, universities are divided into those based on:

- Education;
- Education and scientific research;
- Education and advanced scientific research;

The third level represents the most "practical" of those previously presented. Concrete, accurate data are collected here, taken from different institutions (CNFIS, ANS) and from each university's own reports. In Tab. 3.1 presents the list of proposed indicators, on the 6 dimensions:

Tab. 3.1. ME Indicators

Aspect	Indicator
Dimension 1: Education	
Production	Graduates by study cycle (bachelor's degree, master's degree, doctorate)
	Study programs offered
Resources	The percentage of teaching staff and students
	Different types of rooms, intended for the educational act
	The ratio of education revenue to total university revenue
Communication and digitalization	The ratio between the number of technologically equipped study rooms and the total number of rooms
	Using online teaching software
Dimension 2: Research	
Production	The percentage between the number of publications and the total number of teaching and research staff

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	The percentage of professional publications and the total number of teaching and research staff
	The number of cultural and artistic events organized by teachers
Resources	The ratio of income from grants and projects to the total income of the university
	The ratio of research expenditure to total university expenditure
Communication and digitization	Use of national and international online databases and journals

Dimension 3: Internationalization	
Production	The ratio of international students to the total number of students, from all education cycles
	The ratio of students attracted to international exchange programs and the total number of students
Resources	The ratio of international teaching staff and/or with international diplomas and the total number of teaching staff
	The ratio between the expenses for the promotion and support activities of the international profile of the university and the total expenses of the university
Communication and digitization	The ratio between the number of university pages on websites and in social media, in a language other than Romanian, and the total number of website pages where the university is present

Dimension 4: Social and regional involvement	
Production	The number of graduates from disadvantaged socio-economic backgrounds, in total and by study cycle (bachelor's, master's and doctorate)
	The number of enrollments from the region where the university was located, in total and by study cycle (bachelor's, master's and doctorate)
Resources	The ratio between the number of students with normal and social scholarships and the total number of students, in total and by study cycle (bachelor, master and doctorate)
	The ratio between the expenses regarding the activities supporting the institutional commitment vis-à-vis the community and the total expenses of the university
Communication and digitization	Conformity of the university's web page, relative to international standards

Dimension 5: Transfer de cunoştinţe	
Production	The total number of patents, compared with the total number of teaching staff
	The number of new enterprises, created through start-ups or spin-offs, in relation to the total number of teaching stuff
Resources	The of revenue generated for the university from licenses, patents, new ventures, copyrights and/or contracted consulting work to total revenue
	The ratio between expenses from knowledge transfer activities and total expenses
Communication and digitization	Appearances in the media and social media of teachers or students, regarding the knowledge generated by university for the knowledge transfer process, between the institution and society

Dimension 6: Students	
Production	The ratio of students enrolled through different study methods and the total number of students
	The ratio of students enrolled in study cycles according to their age and the total number of students
Resources	The average cost of fees per year, for bachelor's and master's studies
	The ratio between the budget derived from the payment of taxes and the total budget

Communication and digitization	The ratio of Number of students using various online fee payment facilities to Total number of students

Source: ME, 2018

3.1.2. Romanian Agency for Quality Assurance in Higher Education

RAQAHE provides its own Methodology through which it provides information on authorization processes, accreditation, periodic evaluation, as well as external quality evaluation (RAQAHE, 2017). Basically, universities must comply with certain indicators and/or criteria in order to obtain the status of an authorized or accredited university.

The performance indicators of RAQAHE are grouped into 3 main areas, namely:

A. Institutional capacity;
B. Educational effectiveness;
C. Quality management.

3.1.3. The National Council for Financing of Higher Education

NCFHE was established based on OMECS no. 4243/18.06.2015 regarding the establishment of the National Council for the Financing of Higher Education and ensures, year by year, basic and additional funding for state universities in Romania.

An essential role in the allocation of additional funding is played by quality indicators. In Tab. 3.2 these indicators are presented.

Tab. 3.2. Quality indicators and associated weights - NCFHE

Indicator class	Indicator name	Weight
Scientific research/artistic research (46%)	The quality of human resources	14%
	Impact of scientific activity/artistic creation	12%
	Performance of scientific activity/artistic creation	14%
	Funds allocated for scientific activities/artistic creation	6%
Teaching/learning (22%)	The percentage between the Number of students and the Number of teaching staff	8%
	The percentage of the Number of students from Master's programs and the Number of students from Bachelor's programs	6%
	The percentage of teachers aged up to 41 and the total number of teachers	4%
	The percentage of tenured teaching staff who have the right to lead PhD students and the total number of teaching staff	4%
Regional orientation and social equity (20%)	People from disadvantaged backgrounds in study programs	5%
	The number of places in student dormitories	4%
	Scholarship funds	4%
	Practice carried out by undergraduate students	5%
	Funds with non-reimbursable financing attracted by the institution	2%
International orientation (12%)	The ratio of student mobilities through the ERASMUS and ERASMUS MUNDUS programs	6%
	The ratio of foreign students enrolled in study programs to total students	6%

Total weight	100%

3.2. Analysis of the ranking of Romanian universities and the evaluation criteria at national and international level

To date, two rankings of Romanian universities have been made at the national level:
1. Ad Astra – Top of Romanian Universities – Ranking by fields – 2020 (national) and
2. Kienbanm Management Consultants in collaboration with Capital magazine (national).

Also, at the national level, for more than a few years, the Ministry of Education has launched for public debate the Methodology for classifying universities and ranking study programs.

At the international level, Romania is present with its universities in six such rankings, namely:
1. Shanghai Ranking, conducted by Shanghai Institute of Higher Education;
2. CWTS Leiden Ranking;
3. University Ranking by Academic Performance;
4. QS World University Rankings;
5. SCImago Rankings;
6. THE World University Rankings;
7. Center for World University Ranking – CWUR.

3.2.1. Ranking of universities in Romania made by Ad Astra magazine

In 2020, 28 Romanian universities were identified, out of the 54 accredited ones (including the military academies in Romania), which corresponded to the main criterion (Tab. 3.3.).

Tab. 3.3. University Metaranking 2020

No.	University	Scores	Position
1.	University Babeș-Bolyai of Cluj-Napoca	22	1
2.	University of Bucharest	18	2
3.	University POLITEHNICA of Bucharest	18	2
4.	"Grigore T. Popa" University of Medicine and Pharmacy Iași	13	3
5.	West University of Timișoara	12	4
6.	"Alexandru Ioan Cuza" University of Iași	11	5
7.	University of Medicine and Pharmacy "Carol Davila" Bucharest	10	6
8.	"Iuliu Hațieganu" University of Medicine and Pharmacy	10	6
9.	Transilvania University of Brașov	8	7
10	Bucharest University of Economic Studies	6	8
11	Politehnica University Timișoara	4	9
12	Technical University of Cluj-Napoca	4	9
13	"Gheorghe Asachi" Technical University of Iași	4	9
14	"Dunărea de Jos" University of Galați	3	10
15	"George Emil Palade" University of Medicine, Pharmacy, Science, and Technology of Târgu Mureș	3	10

16	The University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca	3	10
17	University of Craiova	2	11
18	"Victor Babeș" University of Medicine and Pharmacy Timișoara	2	11
19	"Aurel Vlaicu" University of Arad	1	12
20	University of Oradea	1	12
21	University of Pitești	1	12
22	"Lucian Blaga" University of Sibiu	1	12
23	Ovidius University of Constanța	1	12
24	"Ștefan cel Mare" University of Suceava	1	12
25	University of Medicine and Pharmacy of Craiova	1	12
26	University of Agronomic Sciences and Veterinary Medicine of Bucharest	1	12
27	Petroleum - Gas University of Ploiești	1	12
28	Technical University of Civil Engineering Bucharest	1	12

Source: Matu și colab., 2020

Carrying out a brief analysis, in the period 2016-2020, it can be seen how the total score of Romanian universities is increasingly higher, from 78 in 2016, to 163 in 2020. At the same time, Romanian universities are visible at an international level, in 2016 being 20, so that in 2020 it will already be 28. Unfortunately, however, their visibility has decreased compared to 2019, when 30 universities were included in the analyzed rankings.

Tab. 3.4. University metaranking dynamics between 2016-2020

	2016	**2017**	**2018**	**2019**	**2020**
International visibility of Romanian universities	20	23	26	30	28
The total score of Romanian universities	78	90	99	139	163

Source: Matu și colab., 2020

3.2.2. University ranking made by Kienbaum Management Consultants in collaboration with Capital magazine

The research prepared by Kienbaum Management Consultants together with Capital magazine in 2009 had as respondents members of 84 state and private universities (approximately 400 people), but also employees of 35 national and multinational companies, respectively 3,131 graduates of faculty, who took the licensure exam after 1995 [R02].

Tab. 3.5. The ranking of universities made by Kienbaum Management Consultants in collaboration with
Capital Magazine [R02]

Position in ranking	University
1.	"Babeș-Bolyai" University of Cluj - Napoca
2.	University of Bucharest
3.	Transilvania University of Brașov
4.	"Ștefan cel Mare" University of Suceava
5.	"Lucian Blaga" University of Sibiu
6.	"Petre Andrei" University of Iași
7.	The Roman Catholic Theological Institute of Bucharest
8.	"Alexandru Ioan Cuza" University of Iași
9.	Romanian – American University of Bucharest
10.	Technical University of Cluj - Napoca
11.	"Petru Maior" University of Târgu-Mureș
12.	"Gh. Asachi" Technical University of Iași
13.	West University of Timișoara
14.	University of Craiova
15.	Politehnica University Timișoara
16.	North University of Baia-Mare
17.	University of Bacău
18.	Baptist Theological Institute of Bucharest
19.	Petroleum - Gas University of Ploiești
20.	Hyperion University of București
21.	"Gh. Barițiu" University of Brașov
22.	"Dunărea de Jos" University of Galați
23.	"Vasile Goldiș" West University de Vest of Arad
24.	"Titu Maiorescu" University of București
25.	"Spiru Haret" University of București
26.	Bioterra University of București

3.2.3. Ranking of Romanian universities in the Shanghai Ranking

The Shanghai Ranking uses indicators to estimate the quality of education, the teaching staff and the results of the research activity of universities. In order to estimate the score that Romanian universities obtain according to the Shanghai methodology, it is necessary, in principle, to:

- obtaining data corresponding to each indicator, for each university in Romania;
- obtaining data corresponding to each indicator, for at least one university from the top 500, in order to obtain the maximum absolute values (from around the world) of the indicators, based on which the relative scores for Romanian universities are calculated.

Tab. 3.6. The evolution of Romanian universities in the Shanghai Ranking

University	Year		
	2020	2019	2019/2020
"Babeș-Bolyai" University of Cluj-Napoca	701-800	701-800	=
University of Bucharest		901-1000	↘

Source: ARWU (2020). Academic Ranking of World Universities 2020, Available at:
http://www.shanghairanking.com/ARWU2020.html, accessed on15.04.2021

3.2.4. The ranking calculated by the Center for Scientific and Technological Studies of Leiden University (CWTS Leiden Ranking)

Compared to other university rankings, the Leiden ranking offers more advanced bibliometric indicators. The underlying methodology is richly documented. The Leiden Ranking provides information exclusively on research conducted at universities. Research is represented in publications, and carefully collected data about these publications forms the basis of the Leiden ranking.

Tab. 3.7. Dynamics of Romanian universities between 2015-2020 according to CWTS

University	2010-2013	2011-2014	2012-2015	2013-2016	2014-2017	2015-2018	2015-2018/ 2010-2013
"Babeș-Bolyai" University of Cluj - Napoca	789	805	823	873	928	976	↘
University POLITEHNICA of Bucharest	917	942	970	1005	1065	1096	↘

Source: CWTS (2020b). Leiden Ranking 2020. Available at:
https://www.leidenranking.com/ranking/2020/list, accessed on15.04.2021

3.2.5. Ranking of Romanian universities in University Ranking by Academic Performance

Another well-known system for the classification of higher education institutions, in which Romanian universities are present, is University Ranking by Academic Performance.

Tab. 3.8. Romanian universities in the URAP 2021 ranking

Ranking position	University	Articles	Citation	Total document	Presentations	Publications	Weighted citation	Global score
902	"Babeș-Bolyai" University of Cluj - Napoca	44.66	55.98	27.66	47.94	38.92	44.12	259.29
944	University of Medicine and Pharmacy „Carol Davila" of Bucharest	38.84	60.74	27.54	45.08	47.57	33.67	253.44

970	University of Bucharest	43.49	55.3	27.23	45.66	36.9	41.09	249.67
1060	University POLITEHNICA of Bucharest	43.2	51.83	31.94	42.36	33.87	36.57	239.77
1238	”Iuliu Hațieganu” University of Medicine and Pharmacy of Cluj-Napoca	35.02	51.94	23.65	39.67	37.19	33	220.48
1456	„Alexandru Ioan Cuza” University of Iași	32.05	44.24	23.3	36.38	29.83	33.29	199.08
1477	”Grigore Popa” University of Medicine and Pharmacy of Iași	33.23	46.95	25.14	32.25	29.33	30.5	197.4
1549	Bucharest University of Economic Studies	19.14	43.49	22.27	31.5	57.78	16.96	191.14
1696	”Gh. Asachi” Technical University of Iași	23.2	41.23	22.35	32.68	27.53	29.23	176.22
1744	”Transilvania” University of Brașov	26.63	38.69	20.39	30.43	29.38	26.56	172.09
1822	Tehnical University of Cluj - Napoca	21.17	37.14	22.71	30.69	26.62	27.82	166.14
1956	Politehnica University Timișoara	16.33	36.84	21.39	29.89	27.28	23.97	155.7
2220	“Dunărea de Jos” University of Galați	20.89	33.05	17.11	22.79	22.42	20	136.25
2229	The University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca	17.35	32.63	12.65	25.79	24.33	22.94	135.69
2238	West University of Timișoara	18.42	30.7	17.83	24.74	21.37	21.97	135.03
2496	University of Craiova	16.9	25.5	17.44	20.13	16.22	19.53	115.73
2585	”George Emil Palade” University of Medicine, Pharmacy, Science, and Technology of Târgu Mureș	7.9	27.96	16.53	18.79	17.92	20.4	109.5
2622	University of Oradea	15.15	25.51	15.41	16.56	15.91	18.53	107.06
2722	“Lucian Blaga” University of Sibiu	13.63	22.31	13.94	16.4	15.71	17.66	99.65
2841	Ovidius University of Constanța	13.76	20.09	13.82	14.38	12.1	16.9	91.04

Source: URAP, 2021, Rankings. Available at: https://www.urapcenter.org/Rankings/2020-2021/World_Ranking_2020-2021, accessed on16.04.2021.

Since the 2013-2014 academic year, Romanian universities have been present in the URAP Ranking. The presence of universities in these rankings is constant, although the dynamics is not always on an upward trend: if in 2014 there were 11 universities, the number of mentioned universities reached its peak in 2021 with 20 mentioned universities, in 2019 with 18 mentioned universities and at the beginning of 2020 with 16 Romanian universities.

Tab. 3.9. The evolution of Romanian universities in the 2018-2021 URAP ranking

University	2018-2019	2019-2020	2020-2021	2020-2021/ 2018-2019
"Babeș-Bolyai" University of Cluj - Napoca	733	859	902	↘
University POLITEHNICA of Bucharest	760	980	1060	↘
University of Bucharest	841	907	970	↘
University of Medicine and Pharmacy „Carol Davila" of Bucharest	1062	1027	944	↑
"Iuliu Hațieganu" University of Medicine and Pharmacy of Cluj-Napoca	1218	1239	1238	↘
"Alexandru Ioan Cuza" University of Iași	1254	1363	1456	↘
"Grigore Popa" University of Medicine and Pharmacy of Iași	1282	1314	1477	↘
"Gh. Asachi" Technical University of Iași	1397	1549	1696	↘
West University of Timișoara	1502	2080	2238	↘
Tehnical University of Cluj - Napoca	1612	1726	1822	↘
Politehnica University Timișoara	1640	1783	1958	↘
"Transilvania" University of Brașov	1687	1838	1743	↘
Bucharest University of Economic Studies	2010	1751	1549	↑
The University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca	2076	2239	2229	↘
University of Craiova	2202	2446	2496	↘
University of Oradea	2366		2622	↘
Ovidius University of Constanța	2453		2841	↘
"Lucian Blaga" University of Sibiu	2498		2722	↘
"Dunărea de Jos" University of Galați		2119	2220	↘
"George Emil Palade" University of Medicine, Pharmacy, Science, and Technology of Târgu Mureș			2585	

Source: URAP, 2021, Rankings. Available at: https://www.urapcenter.org/Rankings/2020-2021/World_Ranking_2020-2021, accessed on16.04.2021.

3.2.6. The ranking of Romanian universities in QS World University Rankings

Un alt clasament de clasificare și ierarhizare universitară, în care sunt prezente universitățile românești, este QS World University Rankings.

Another university classification and ranking of the universities, in which Romanian universities are present, is the QS World University Rankings.

Tab. 3.10. The evolution of Romanian universities in the QS World University Rankings

No.	University	Year					2017/ 2021
		2021	**2020**	**2019**	**2018**	**2017**	
1.	University „Babeș-Bolyai" din Cluj-Napoca	801-1000	801-1000	801-1000	801-1000	701-750	↘
2.	University of Bucharest	801-1000	801-1000	801-1000	701-750	701-750	↘
3.	"Alexandru Ioan Cuza" University of Iași	-	-	801-1000	801-1000	701-750	↘
4.	University POLITEHNICA of Bucharest	-	-	801-1000	-	-	
5.	West University of Timișoara	-	-	801-1000	801-1000	701-750	↘
6.	Technical University of Cluj-Napoca	-	801-1000				
7.	University Tehnică „Gheorghe Asachi" din Iași	-	801-1000				

Source: QS, (2021a), QS World University Rankings 2021, Available at https://www.qschina.cn/en/university-rankings/world-university-rankings/2021, accessed on16.04.2021.

Compared to 2017, when 4 Romanian universities were mentioned in this ranking ("Babeș-Bolyai" University from Cluj-Napoca, University of Bucharest, "Alexandru Ioan Cuza" University of Iași and West University of Timișoara), only in 2019 mentioned University POLITEHNICA of Bucharest. The number of Romanian universities visible in this ranking is therefore, in 2019, 5. Unfortunately, in 2020 and 2021, although new Romanian universities joined, only two of them took a position between 801-1000.

3.2.7. Ranking of Romanian universities in SCImago Rankings

The SCImago Institution Ranking (SIR) is a ranking of academic and research institutions, classified by a composite indicator, which combines three different sets of indicators, based on: research performance (50%), innovation results (30%) and societal impact (20%), quantified by the visibility of the institutions in the online environment.

Tab. 3.11. Ranking of Romanian universities, according to SCImago Ranking 2021

	University	Ranking position in 2020	Ranking position in 2021	2020 / 2021
1.	"Iuliu Hațieganu" University of Medicine and Pharmacy	683	707	↑
2.	University POLITEHNICA of Bucharest	690	699	↑
3.	"Babeș-Bolyai" University of Cluj-Napoca	703	696	↘
4.	"Alexandru Ioan Cuza" University of Iași	720	760	↑
5.	University of Bucharest	723	740	↑
6.	University of Agricultural Sciences and Veterinary Medicine of Cluj-Napoca	724	722	↘
7.	University of Medicine and Pharmacy "Carol Davila" Bucharest	728	737	↑
8.	Technical University of Cluj-Napoca	756	760	↑
9.	Transilvania University of Brașov	763	769	↑
10.	University of Medicine and Pharmacy of Târgu Mureș	776	774	↘
10.	"Victor Babeș" University of Medicine and Pharmacy Timișoara	776	774	↘
11.	"Grigore T. Popa" University of Medicine and Pharmacy Iași	785	772	↘
11.	"Gheorghe Asachi" Technical University of Iași	785	792	↑
11.	"Ștefan cel Mare" University of Suceava	785	795	↑
12.	West University of Timișoara	793	792	↘
12.	University Politehnică din Timișoara	793	766	↘
13.	University of Oradea	802	799	↘
14.	Bucharest University of Economic Studies	806	819	↑
15.	"Dunărea de Jos" University of Galați	812	825	↑
16.	University of Craiova	814	834	↑
17.	"Aurel Vlaicu" University of Arad	823		-
18.	University of Medicine and Pharmacy of Craiova	824	822	↘
19.	Technical University of Civil Engineering from Bucharest	829	843	↑
20.	University of Pitești	832	832	=
21.	"Lucian Blaga" University of Sibiu	841	841	=
22.	Valahia University of Târgoviște	845	-	-
23.	University of Agronomic Sciences and Veterinary Medicine of Bucharest	847	849	↑
24.	Ovidius University of Constanța	853	860	↑
25.	Titu Maiorescu University	855	-	-
26.	Petroleum - Gas University of Ploiești	856	850	↑
27.	University of Petroșani	882	-	-

Source: https://www.scimagoir.com/rankings.php?sector=Higher+educ.&country=ROU&year=2015

3.2.8. Ranking of Romanian universities in THE (THE World University Rankings)

The Times Higher Education World University Rankings is another tool for ranking higher education universities around the world. According to THE World University Ranking, at the end of 2021 there were 13 Romanian universities in this ranking, the ranking of Romanian universities being as follows (Tab. 3.12):

Tab. 3.12. Ranking of Romanian universities according to THE World University Ranking

Position	University	Total	Academical reputation	Research	Citation	Technological transfer	International perspective
601-800	Bucharest University of Economic Studies	30.2 – 36.3	15.6	10.8	69.6	34.5	22.1
801-1000	"Iuliu Hațieganu" University of Medicine and Pharmacy of Cluj-Napoca	25.1 – 30.1	20.0	8.6	41.5	33.5	50.3
1001+	"Alexandru Ioan Cuza" University of Iași	10.3 – 25.0	17.1	11.4	12.5	33.4	32.1
1001+	"Babeș-Bolyai" University of Cluj - Napoca	10.3 – 25.0	18.1	14.8	34.3	33.9	49.6
1001+	University of Bucharest	10.3 – 25.0	19.0	10.9	13.9	36.6	26.6
1001+	"Dunărea de Jos" University of Galați	10.3 – 25.0	15.0	8.4	7.5	33.4	37.8
1001+	"George Emil Palade" University of Medicine, Pharmacy, Science, and Technology of Târgu Mureș	10.3 – 25.0	15.2	8.3	13.3	33.5	28.5
1001+	"Grigore T. Popa" University of Medicine and Pharmacy Iași	10.3 – 25.0	18.6	7.9	12.7	33.6	39.6
1001+	University POLITEHNICA of Bucharest	10.3 – 25.0	16.0	11.1	11.8	33.9	21.3
1001+	Politehnica University Timișoara	10.3 – 25.0	14.7	8.2	13.8	34.3	19.3
1001+	Technical University of Cluj-Napoca	10.3 – 25.0	15.4	10.4	17.6	35.5	22.1
1001+	"Transilvania University of Brașov	10.3 – 25.0	14.0	9.8	19.3	34.4	26.3

| 1001+ | West University of Timișoara | 10.3 – 25.0 | 18.2 | 9.3 | 11.9 | 34.4 | 27.5 |

Source: THE, (2021a), World University Rankings 2021, Available at: <u>World University Rankings 2021 | Times Higher Education (THE)</u>, accessed on15.05.2021

Tab. 3.13. The evolution of Romanian universities in THE World University Ranking

No.	University	Year					
		2021	2020	2019	2018	2017	2016
1.	Bucharest University of Economic Studies	601-800	801-1000	1001+			
2.	"Iuliu Hațieganu" University of Medicine and Pharmacy of Cluj-Napoca	801-1000		801-1000			
3.	"Alexandru Ioan Cuza" University of Iași	1001+	1001+	1001+	801-1000	801+	601-800
4.	"Babeș-Bolyai" University of Cluj - Napoca	1001+	801-1000	801-1000	601-800	601-800	501-600
5.	University of Bucharest	1001+	1001+	801-1000	801-1000	801+	601-800
6.	"Dunărea de Jos" University of Galați	1001+					
7.	"George Emil Palade" University of Medicine, Pharmacy, Science, and Technology of Târgu Mureș	1001+					
8.	"Grigore T. Popa" University of Medicine and Pharmacy Iași	1001+	1001+	1001+	801-1000		
9.	University POLITEHNICA of Bucharest	1001+	1001+				
10.	Politehnica University Timișoara	1001+	1001+				
11.	Technical University of Cluj-Napoca	1001+	1001+				
12.	"Transilvania University of Brașov	1001+					
13.	West University of Timișoara	1001+	1001+	1001+	801-1000	601-800	601-800

Source: THE, (2021a), World University Rankings 2021, Available at: World University Rankings 2021 | Times Higher Education (THE), accessed on15.05.2021

3.2.9. Ranking of Romanian universities in the International University Ranking (Center for World University Ranking – CWUR)

CWUR uses 7 carefully selected indicators to rank universities around the world. According to CWUR, the ranking of institutions in Romania, at the beginning of 2021, is presented as follows (Tab. 3.14):

Tab. 3.14. Ranking of Romanian universities according to CWUR 2021

International Ranking	Institution	National ranking	Quality of education	Graduate employability	Teachers with Nobel or Fields prizes	Research performance	Global score
871	University „Babeș-Bolyai" din Cluj-Napoca	1	-	-	-	824	71.0
891	University POLITEHNICA of Bucharest	2	-	-	-	846	70.9
1010	University of Bucharest	3	356	-	-	969	70.2
1162	West University of Timișoara	4	-	-	-	1106	69.3
1217	University of Medicine and Pharmacy "Carol Davila" Bucharest	5	-	-	-	1152	69.0
1452	"Alexandru Ioan Cuza" University of Iași	6	-	-	-	1388	67.9
1489	"Iuliu Hațieganu" University of Medicine and Pharmacy of Cluj-Napoca	7	-	-	-	1422	67.7
1639	"Grigore T. Popa" University of Medicine and Pharmacy Iași	8	-	-	-	1564	67.1
1665	"Transilvania University of Brașov	9	-	-	-	1593	67.0
1928	University de Medicină și Farmacie „Victor Babeș" din Timișoara	10	-	-	-	1852	66.0

Source: CWUR, (2021), World University Rankings 2021, Available at: https://cwur.org/2021-22.php, accessed on 15.05.2021

Tab. 3.15. The evolution of Romanian universities in the 2018-2021 CWUR ranking

University	2015	2016	2017	2018	2019	2020	2021	2021/ 2019
„Babeș-Bolyai" University of Cluj-Napoca	987	980	975	802	881	862	871	↑
University POLITEHNICA of Bucharest				817	917	893	891	↑
University of Bucharest	986	977	939	827	955	981	1010	↘
West University of Timișoara					1260	1186	1162	↑
University of Medicine and Pharmacy "Carol Davila" Bucharest					1145	1198	1217	↘
"Alexandru Ioan Cuza" University of Iași					1350	1416	1452	↘
"Iuliu Hațieganu" University of Medicine and Pharmacy of Cluj-Napoca					1425	1423	1489	↘
"Grigore T. Popa" University of Medicine and Pharmacy Iași					1527	1564	1639	↘
"Transilvania University of Brașov					1844	1700	1665	↘
"Victor Babeș" University of Medicine and Pharmacy Timișoara					1821	1890	1928	↘
"Gheorghe Asachi" Technical University of Iași					1651	1860	-	↘
Politehnica University Timișoara					1939			
Technical University of Cluj					1989			

Source: CWUR, (2021), World University Rankings 2021, Available at: https://cwur.org/2021-22.php, accessed on15.05.2021.

3.3 Conclusions

Considering the indicators and rankings mentioned above, a centralization of the 10 best ranked Romanian universities/institutions will be made, from the 8 analyzed rankings (1 national and 7 international) (Tab. 2.16.). We note that, since the Ranking of universities made by Kienbaum Management Consultants in collaboration with Capital magazine has not been updated to the level of 2020 or 2021, we cannot use it in the analysis undertaken.

The ranking of Romanian universities, made by Ad Astra magazine, was compiled based on the opinions of Romanian researchers from the country and abroad, despite the fact that very few indicators were taken into account. Also, another issue raised is that separate rankings should be made: a top ranking state universities and a top ranking private universities.

The ranking of Universities made by Kienbaum Management Consultants, in collaboration with Capital magazine, is a relative one, which, being made only in 2009, is not of high interest. Even in this case, relevant indicators were not taken into account, resulting in situations like:

- Position 8: Romanian-Catholic Theological Institute Bucharest;
- Position 9: "Alexandru Ioan Cuza" University of Iași.

Romanian universities appear with a fairly low frequency in international university ranking systems. And not necessarily because they do not meet certain criteria, but because they do not register in such rankings, not providing the data needed to apply in such mechanisms.

Despite the fact that there was Government Decision no. 789/2011 which regulates the possibility of ranking universities in Romania, a top ranked Romanian universities does not exist.

International rankings such as Shanghai, CWTS, University Ranking by Academic Performance, QS World University Rankings, SCImago Rankings, THE and CWUR, in which Romanian universities are present, represent a starting point for creating a ranking of Romanian universities, however, for achieving it requires an impressive number of data. Romanian universities are not present in the other two international US News and Report Rankings, nor in the Ranking of the performance of scientific works of universities around the world. However, we notice more and more Romanian universities joining these rankings.

Tab. 3.16. Centralization of the most prestigious Romanian universities

No.	University/ Institution name	National ranking	International ranking								Apparitions
		Ad Astra	ARWU	CWTS	SCImago	URAP	QS WUR	THE	CWUR	
1.	Babeș-Bolyai" University of Cluj-Napoca	1	1	1	1	1	1	1	1	8
2.	University POLITEHNICA of Bucharest	1	0	1	1	1	0	1	1	6
3.	University of Bucharest	1	0		1	1	1	1	1	6
4.	"Alexandru Ioan Cuza" University of Iași	1	0	0	1	1	0	1	1	5
5.	University of Medicine and Pharmacy "Carol Davila" Bucharest	1	0	0	1	1	0	1	1	5
6.	"Grigore T. Popa" University of Medicine and Pharmacy Iași	1	0	0	0	1	0	1	1	4
7.	Transilvania University of Brașov	1	0	0	1	1	0	0	1	4
8.	"Iuliu Hațieganu" University of Medicine and Pharmacy	1	0	0	0	0	1	1	0	3
9.	Bucharest University of Economic Studies	1	0	0	0	1	0	1	0	3

No.	Institution									
10.	"George Emil Palade" University of Medicine, Pharmacy, Science, and Technology of Târgu Mureş	1	0	0	1	0	0	1	0	3
11.	West University of Timişoara	1	0	0	0	0	0	0	1	2
12.	Politehnica University Timişoara	1	0	0	0	0	0	1	0	2
13.	Technical University of Cluj-Napoca	1	0	0	1	0	0	0	0	2
14.	"Gheorghe Asachi" Technical University of Iaşi	1	0	0	0	1	0	0	0	2
15.	"Dunărea de Jos" University of Galaţi	1	0	0	0	0	0	1	0	2
16.	The University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca	1	0	0	1	0	0	0	0	2
17.	University de Medicină şi Farmacie „Victor Babeş" din Timişoara	0	0	0	1	0	0	0	1	2

Chapter 4. Research on the definition of relevant indicators for ranking
4.1. Weighting methodology used

The AHP method was used as a decision-making tool to classify the perceived relative importance of the factors involved in the process of developing university rankings. Through this methodology, we aim to capture additional aspects of university ranking methodologies that complement the existing expertise in the research area.

4.2. Research stages

- *Stage 1*: Detailed analysis of the literature to identify and classify all indicators that are used by international rankings:
  - Methodology: critical review of scientific literature and international rankings;
  - Tool used: Google Scholar and ranking websites.
- *Stage 2*: Centralization of the most frequently used indicators in international rankings:
  - Methodology: review of the weights and occurrences of the indicators in the international rankings
  - Tool used: Ranking websites and Microsoft XLS.
- *Stage 3*: Prioritizing indicators from international rankings:
  - Methodology: AHP technique;
  - Tool used: Microsoft XLS.
- *Stage 4*: Research results - Centralization of indicators according to the obtained weights (3 variants):
  - Methodology: AHP technique;
  - Tool used: Microsoft XLS.

As a result, a number of indicators (49) were identified, used in the 9 analyzed international rankings, as shown in Table 4.1:

Tab. 4.1. Centralization of indicators stage 1 (total indicators)

No.	Indication name	Indicator description
1.	Publications in the most cited journals	Number of publications in the Web of Science database, Nature and/or Science or other top 10% specialist publications
2.	Publications in prestigious journals	The number of publications that appeared in the most prestigious specialized magazines
3.	Citation Impact Factor in Clarivate Analytics	Citation Impact Factor, calculated in the Clarivate Analytics database
4.	Percentage of publications in the most cited journals	Percentage of articles appearing in Web of Science, Nature, and/or Science or other top 10% publications
5.	International collaborations	Number of co-authored articles
6.	Total citations	The total number of cited researchers, who in turn enjoy a high number of citations
7.	Edited volumes	Number of volumes edited by a higher education institution/university

8.	conference	The total number of conferences organized within a higher education institution/university
9.	Global reputation for conducted research	The reputation acquired by the institution, worldwide
10.	Regional reputation for conducted research	The reputation acquired by the institution, at the regional level, according to the UN definition
11.	Scientific excellence	Percentage of publications in the most cited 1% journals and journals
12.	Teachers with Nobel or Fields prizes	Number of faculty who have won Nobel or Fields Prizes from a higher education institution/university or other high-impact competitions
13.	Papers indexed in the journal Science Citation Index	The number of papers idexed in the journal of Science Citation
14.	Quality of education	The number of graduates who have obtained nobel or fields prizes or other international distinctions or special results of competitions rated as having an impact
15.	Academic performance	Individuals from a higher education institution/university who have performed performance activities
16.	Open access publication	Total number of publications with "open access status" as determined based on unpaywall data
17.	Gender diversity	The total number of authorities of a university. For each university authority, the gender is determined using a four-step procedure: author disambiguation (using an author disambiguation algorithm, there must be sufficient evidence to assume that different publications were authored by the same individual), connecting the author with a specific country (each author is linked to one or more countries. If the Country of the author's first publication is the same as the one that appears most often in the author's publications, the author is linked to this country. If meaningful, the author is linked to all countries that appear in his publications), retrieval of gender statistics (for each author, gender statistics are obtained based on an author's first name and the countries with which the author is related), gender assignment (for each author, a gender is assigned)
18.	Impact of citations	The impact of citations, taking into account the definition given by the Karolinska Institute in Sweden
19.	Excellence in leadership	The amount of documents cited in the most prestigious magazines and journals in which the respective higher education institution/university is the main contributor
20.	Articles from Scopus	The number of articles published in publications that are already indexed in the Scopus database
21.	Scientific leadership	The amount of scientific production of a higher education institution/university that is included in the first 10% of the most cited papers in specialized fields
22.	Own magazines	The number of articles published in the own journals of a higher education institution/university

23.	Articles in own journals	Number of journals published by a higher education institution/university
24.	Scientific talent pool	Total number of authors from a higher education institution/university who have published articles, in a given time period
25.	PATENTS	The total number of patents from a higher education institution/university registered in the PATSTAT database
26.	Patents in a specific category	The percentage of patents, in a certain category, from a higher education institution/university registered in the PATSTAT database
27.	Technological impact	Percentage of scientific output that is cited in patents
28.	Altmetrics	The indicator by which 10% of the best documents are calculated, regarding their impact value, which takes into account both the number of documents that have several mentions in the PLUMX METRICS social network, but also in Twitter, Facebook, on blogs, etc. (70%), but also the Number of documents that have more than one reader in the Mendeley software (30%)
29.	Links	The number of links associated with the website of the higher education institution/university, taking into account the statistics of AHREFS - a tool for increasing traffic in the online environment, in terms of searching for information, researching competitors and monitoring
30.	Web size	The number of pages that are associated with the URL of the higher education institution/university
31.	Citations report	The ratio between the average number of citations and/or publications in a certain field, from a higher education institution/university and the average number of citations and/or publications in the same field, at international level
32.	Weighted citation ratio	The ratio between the average number of citations and/or publications in a certain field in a higher education institution/university and the average number of citations and/or publications in the same field, internationally, weighted by the average of citations for 41 fields of specialty, chosen by URAP representatives
33.	presentation	The total number of presentations made by teaching staff from a higher education institution during conferences, seminars, reviews, notes, letters, etc. Made that were entered in a different profile magazine than the web of science
34.	Academic reputation	Questionnaire through which the best-known authors of academic publications in the fields they belong to present their opinion on the respective higher education institution
35.	Personal report – students	The ratio between the number of employees of higher education institutions/universities and the students enrolled in the respective higher education institution/university
36.	Reputation with employers	The reputation held in the market among employers by the institution of higher education/University
37.	Internationalization of the university	The ratio between the number of teaching staff of the higher education institution/university and the number of international students that the higher education institution/university has and, at the same time, the total number of students within the university and its international students

38.	Doctoral	The number of PhD students who remain and are part of the academic body
39.	Undergraduate – Ph.D. student report	Percentage of undergraduate and doctoral students
40.	Income of the institution	The total revenue that a higher education institution/university has, within a year
41.	Research revenue	The part of the total income that comes from the research activity
42.	Domestic students - foreign students ratio	The share of total revenue that comes from research activities
43.	Employees - foreign students ratio	The ratio between the number of domestic students and students coming from other states
44.	Technological transfer	The ratio between the number of employees and students coming from other states
45.	Graduate employability	The ratio between the revenues obtained from various collaborations with the industrial environment and the purchasing power parity of the Country where the respective university is located
46.	Total items	The ratio between the size of the higher education institution/university and the number of graduates employed in and holding management positions in companies considered to be the best worldwide
47.	Articles in 2 years	The total number of articles published by a higher education institution/university in the last 11 years
48.	Citations in 2 years	The total number of articles published by a higher education institution/university in the last 2 years
49.	Average of citations	The total number of citations made by a higher education institution/university, in the last 2 years

Centralizing the data, we find that, from the percentage perspective of the indicators, in the 9 analyzed international rankings, the situation is presented according to the table below:

Tab. 4.2. Centralization of indicators from the perspective of % indicators in the 9 international rankings

Indicator	%
Total citations	102.50%
Publications in the most cited journals	85.50%
Academic reputation	55%
International collaborations	54.50%
Quality of education	35%
Impact of citations	33%
Publications in prestigious journals	31%
Percentage of publications in the most cited journals	30%
Teachers with Nobel or Fields prizes	30%
Scientific excellence	27%
Open access publication	27%
Gender diversity	25%

Graduate employability	25%
Personal report - students	24.50%
Papers indexed in the journal Science Citation Index	20%
Global reputation for research conducted	18.50%
Citations report	18%
Weighted citation ratio	15%
Articles in the current year	15%
Articles in Scopus	14%
Regional reputation for research conducted	12.50%
Citation Impact Factor in Clarivate Analytics	10%
Academic performance	10%
PATENTS	10%
Patents in a specific category	10%
Technological impact	10%
Altmetrics	10%
presentation	10%
Reputation with employers	10%
Internationalization of the university	10%
Total items	10%
Citations in 2 years	10%
Average of citations	10%
Excellence in leadership	8%
Doctoral	6%
Research revenue	6%
Scientific leadership	5%
Links	5%
Web size	5%
Articles in own journals	3%
Own magazines	3%
Edited volumes	2.50%
conference	2.50%
Domestic students - foreign students ratio	2.50%
Employees - foreign students ratio	2.50%
Technological transfer	2.50%
Bachelor's - PhD student ratio	2.25%
Income of the institution	2.25%
Scientific talent pool	2%

Centralizing the data, this time from the perspective of the indicators' appearances in the 9 analyzed international rankings, the situation is presented according to the table below:

Tab. 4.3. Centralization of indicators from the perspective of the number of occurrences of the indicators in the 9 international rankings

Indicator	No. of appearances
Publications in the most cited journals	6
Total citations	6
International collaborations	5
Scientific excellence	3
Impact of citations	3
Publications in prestigious journals	2
Percentage of publications in the most cited journals	2
Global reputation for research conducted	2
Teachers with Nobel or Fields prizes	2
Quality of education	2
Open access publication	2
Articles in Scopus	2
Academic reputation	2
Personal report - students	2
Citation Impact Factor in Clarivate Analytics	1
Edited volumes	1
conference	1
Regional reputation for research conducted	1
Papers indexed in the journal Science Citation Index	1
Academic performance	1
Gender diversity	1
Excellence in leadership	1
Scientific leadership	1
Articles in own journals	1
Own magazines	1
Scientific talent pool	1
PATENTS	1
Patents in a specific category	1
Technological impact	1
Altmetrics	1
Links	1
Web size	1
Citations report	1
Weighted citation ratio	1
presentation	1
Reputation with employers	1

Internationalization of the university	1
Doctoral	1
Bachelor's - PhD student ratio	1
Income of the institution	1
Research revenue	1
Domestic students - foreign students ratio	1
Employees - foreign students ratio	1
Technological transfer	1
Graduate employability	1
Total items	1
Articles in the current year	1
Citations in 2 years	1
Average of citations	1

The third stage represents the stage of prioritization of indicators from international rankings and academic literature. Each main category is assigned at least two indicators:

1. General:
    a. The total number of students;
        i. Total number of international students;
        ii. The total number of local students;
    b. The total number of teaching staff;
    c. The total number of auxiliary personnel;
    d. Number of publications in the last year;
    e. The total number of citations.
2. Bibliometrics:
    a. Publications in the most cited journals;
    b. Publications in prestigious journals.
3. Education:
    a. Teacher/student ratio;
    b. Education revenue as a percentage of total university revenue.
4. Research:
    a. Income from grants and research projects as a percentage of the university's total income;
    b. Research expenses as a percentage of the university's total expenses;
    c. Research productivity.
5. Innovation:
    a. Certificates granted per total number of teaching staff;
    b. The number of doctoral degrees awarded.
6. Internationalization of the university:
    a. Foreign students/domestic students ratio (Percentage of international students enrolled in any study cycle against the total number of students enrolled);
    b. International collaborations.

7. Institutional reputation:
    a. Number of conferences organized;
    b. Partnerships with other institutions;
    c. Internship programs.
8. Sustainability:
    a. The ratio between sustainability courses and the total of courses/subjects;
    b. The ratio between sustainable research funding and total research funding;
    c. Number of scientific publications on sustainable development;
    d. Ecological projects implemented;
    e. Environmental responsibility awareness events.

4.3. Description and critical analysis of the chosen indicators

In the following, the 18 indicators chosen to be part of the proposed study will be analyzed, to which are added those from the "General" category, in Number of 5.

1. a. Total number of students: refers to the total number of students enrolled in a university, in the three education cycles.

1.b. Total number of teachers. This indicator refers to the total number of teaching staff (tenured, associate, who have an employment contract with the higher education institution).

Another indicator from the General category is "*1.c. Total number of auxiliary staff*". For this indicator, people other than those indicated in the point above will be taken into account and a few examples can be given: administrative staff, laboratory workers, caretakers, guards, etc.

The "General" category also includes the indicator "*1.d. The number of publications in the last year*". For this indicator, the total number of scientific articles, published in specialized magazines around the world, is taken into account.

The last indicator in this category is "*1.e Number of citations*". This indicator refers to the total number of citations made in the most well-known specialist magazines around the world.

The "Bibliometrics" category includes the indicator "*2.a. Publications in the most cited journals*". It refers to the Number of publications in the Web of Science database, Nature and/or Science or other top 10% specialized publications;

The indicator 2.b. is also part of the "Bibliometrics" category. "*Publications in prestigious journals*", which refers to the number of publications that appeared in the most prestigious specialized journals.

"Education" category - indicator "*3.a. Teacher/student ratio*". The teacher/student ratio will take into account the total number of teaching staff (at the beginning of an academic year) who have registered an individual work, collaboration or other form contract with the University and the total number of those enrolled within a university, at the three education cycles.

"Education" category - indicator "*3.b. Education revenue as a percentage of total university revenue*". We measure the quality of education using the metric "Revenues from education as a percentage of the total revenues of the university", respectively the ratio between "Total revenues of the university in lei" and "Total revenues obtained from the amounts received from the Ministry of Education.

Category "Research" - indicator "*4.a. Income from grants and research projects as a percentage of total university income*". The indicator revenues from subsidies and research

projects, as a percentage of the total revenues of the university, refers to the total revenues of the institution intended for research activity.

Category "Research" - indicator "*4.b. Research expenditure as a percentage of total university expenditure*". As part of this, the quality of institutional research is measured using our "Research expenditure as a percentage of total university expenditure" metric.

Category "Research" - indicator "*4.c. Research productivity*". Research productivity in this case refers to the variety of fields that are covered in producing publications, articles, citations, etc.

Category "Innovation" - indicator "*5.a. Certificates awarded per total number of teaching staff*". This indicator refers to the share of the total number of invention patents that have a technical character.

Category "Innovation" - indicator "*5.b. The number of doctor's degrees awarded*". This indicator refers to the total number of Doctor Honoris Causa titles awarded by the university in a calendar year.

Category "Internationalization of the university" - indicator "*6.a. Foreign students/domestic students ratio*".

Category "Internationalization of the university" - indicator "*6.b. International collaboration*". The indicator refers to the partnerships that a certain higher education institution concludes with another such institution, outside the country where the University operates.

"Institutional reputation" category - indicator "*7.a. Number of conferences organized*": this indicator refers to the number of conferences that a university organizes, both locally, regionally, internationally or in partnership with other institutions or the university.

"Institutional reputation" category - indicator "*7.b. Partnerships with other institutions*": the indicator refers to the number of partnerships that an educational institution concludes with other institutions, other than educational ones, at the local, regional level or on the territory of the country where the University operates.

"Institutional reputation" category - indicator "*7.c. Internship programs*": the indicator refers to the total number of internship programs in which an educational institution engages in order for students to benefit from the realization of practical activities, other than those they carry out in the university.

"Sustainability" category - indicator "*8.a. The ratio of sustainability/sustainable development courses to total courses/subjects*": this indicator refers to the average of sustainability courses, therefore on sustainable development topics, and the total number of courses.

Category "Sustainability" - indicator "*8.b. Ratio of sustainable research funding to total research funding*": this indicator is the average of sustainable research funding to total research funding.

"Sustainability" category - indicator "*8.c. The number of scientific publications on sustainable development*": this indicator refers to the number of scientific publications of all teaching staff on sustainable development topics, divided by the number of teaching staff.

"Sustainability" category - indicator "*8.d. Ecological projects implemented*": this indicator refers to the number of ecological projects implemented within the university.

"Sustainability" category - indicator "*8.e. Environmental responsibility awareness events*": this indicator refers to the number of environmental responsibility awareness events held within the university, not including scientific conferences.

4.4. Research results - Centralization of indicators according to the obtained weights (3 variants)

In the following, we will present the 3 variants that were chosen as a result of the AHP analysis, with the mention that these categories were divided into main categories and secondary categories, which change according to their importance within each variant. Each category considered secondary will have a weight of 10%, therefore, regardless of the variant, the weight of the secondary categories remains unchanged. Only the weight of the main categories changes, which will vary as seen in Fig. 4.1:
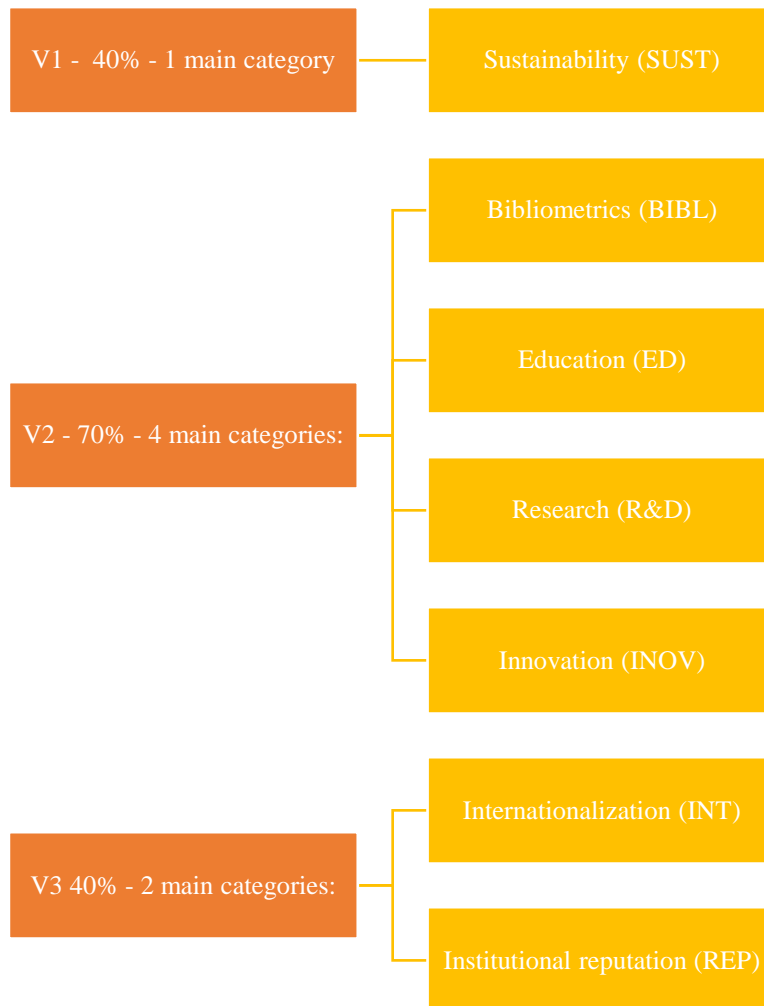
Fig. 4.1. Main categories of the 3 chosen variants

- 40% (variant 1 which has only one main category - Sustainability (SUST));
- 70% (variant 2 which has 4 main categories: Bibliometrics (BIBL), Education (ED), Research (R&D) and Innovation (INOV);
- 50% (variant 3 which has two main categories: Internationalization (INT) and Institutional Reputation (REP)).

4.4.1. Variant 1 (V1)

In the first proposed variant (V1), the focus will be on Sustainability (SUST), while the other categories will have an equal weight. Thus, the Sustainability category will hold 40%, and Bibliometrics (BIBL), Education (ED), Research (R&D), Innovation (INOV), Internationalization (INT) and Institutional Reputation (REP) will each hold 10%, according to the table above down:

Tab. 4.4. Suggested indicators and categories for use (V1)

No.	Criterion	Points	Weight
1.	Bibliometrics (BIBL)		10%
BIBL 1	Publications in the most cited journals	500	
BIBL2	Publications in prestigious journals	500	
	TOTAL	**1000**	
2.	Education (ED)		10%
ED1	Teacher/student ratio	500	
ED2	Education revenue as a percentage of total university revenue	500	
	TOTAL	**1000**	
3.	Research (R&D)		10%
R&D1	Income from grants and research projects as a percentage of total university income	250	
R&D2	Research expenditure as a percentage of total university expenditure	250	
R&D3	Research productivity	250	
R&D4	Services offered by the university to facilitate research/Subscriptions	250	
	TOTAL	**1000**	
4.	Innovation (INOV)		10%
INOV1	Patents/professors ratio	500	
INOV2	The number of doctoral degrees awarded	500	
	TOTAL	**1000**	
5.	Internationalization (INT)		10%
INT1	Foreign students/domestic students ratio	500	
INT2	International collaborations	500	
	TOTAL	**1000**	
6.	Institutional reputation (REP)		10%
REP1	The number of conferences organized	300	
REP2	Partnerships with other institutions	400	
REP3	Internship programs	300	
	TOTAL	**1000**	
7.	Sustainability (SUST)		40%
SUST1	Ratio of sustainability courses to total courses/subjects	700	
SUST2	Ratio of sustainable research funding to total research funding	700	
SUST3	The ratio between the number of scientific publications on sustainability and total teaching staff	1200	

No.	Criterion	Points	Weight
SUST4	Ecological projects implemented	700	
SUST5	Environmental responsibility awareness events	700	
	TOTAL	**4000**	

4.4.2. Variant 2 (V2)

In the context where higher education institutions are leaders in education, research and innovation, the second proposed variant (V2) emphasizes Bibliometrics (BIBL), Education (ED), Research (R&D) and Innovation (INOV), while the other categories will hold an equal weight. Thus, the categories Bibliometrics (BIBL), Education (ED), Research (R&D) and Innovation (INOV) will hold 70% and 17.5% respectively, and Internationalization (INT), Institutional Reputation (REP) and Sustainability (SUST) will each own 10%, according to the table below:

Tab. 4.5. Suggested indicators and categories for use (V2)

No.	Criterion	Points	Weight
1.	Bibliometrics (BIBL)		17.5%
BIBL 1	Publications in the most cited journals	875	
BIBL2	Publications in prestigious journals	875	
	TOTAL	**1750**	
2.	Education (ED)		17.5%
ED1	Teacher/student ratio	875	
ED2	Education revenue as a percentage of total university revenue	875	
	TOTAL	**1750**	
3.	Research (R&D)		17.5%
R&D1	Income from grants and research projects as a percentage of total university income	400	
R&D2	Research expenditure as a percentage of total university expenditure	400	
R&D3	Research productivity	550	
R&D4	Services offered by the university to facilitate research/Subscriptions	400	
	TOTAL	**1750**	
4.	Innovation (INOV)		17.5%
INOV1	Patents/professors ratio	875	
INOV2	The number of doctoral degrees awarded	875	
	TOTAL	**1750**	
5.	Internationalization (INT)		10%
INT1	Foreign students/domestic students ratio	500	
INT2	International collaborations	500	
	TOTAL	**1000**	
6.	Institutional reputation (REP)		10%
REP1	The number of conferences organized	300	
REP2	Partnerships with other institutions	400	
REP3	Internship programs	300	

	TOTAL	**1000**	
7.	Sustainability (SUST)		10%
SUST1	Ratio of sustainability courses to total courses/subjects	200	
SUST2	Ratio of sustainable research funding to total research funding	200	
SUST3	The ratio between the number of scientific publications on sustainability and total teaching staff	200	
SUST4	Ecological projects implemented	200	
SUST5	Environmental responsibility awareness events	200	
	TOTAL	**1000**	

4.4.3. Variant 3 (V3)

In the third proposed variant (V3), the focus will be on Internationalization (INT) and Institutional Reputation (REP), while the other categories will have an equal weight. Thus, the categories Internationalization (INT) and Institutional Reputation (REP) will hold 50%, and Bibliometrics (BIBL), Education (ED), Research (R&D), Innovation (INOV) and Sustainability (SUST) will hold the rest of the weight, i.e. each 10% each, according to the table below:

Tab. 4.6. Suggested indicators and categories for use (V3)

No.	**Criterion**	**Points**	**Weight**
1.	Bibliometrics (BIBL)		10%
BIBL 1	Publications in the most cited journals	500	
BIBL2	Publications in prestigious journals	500	
	TOTAL	**1000**	
2.	Education (ED)		10%
ED1	Teacher/student ratio	500	
ED2	Education revenue as a percentage of total university revenue	500	
	TOTAL	**1000**	
3.	Research (R&D)		10%
R&D1	Income from grants and research projects as a percentage of total university income	250	
R&D2	Research expenditure as a percentage of total university expenditure	250	
R&D3	Research productivity	250	
R&D4	Services offered by the university to facilitate research/Subscriptions	250	
	TOTAL	**1000**	
4.	Innovation (INOV)		10%
INOV1	Patents/professors ratio	500	
INOV2	The number of doctoral degrees awarded	500	
	TOTAL	**1000**	
5.	Internationalization (INT)		25%

INT1	Foreign students/domestic students ratio	1500	
INT2	International collaborations	1000	
	TOTAL	**2500**	
6.	Institutional reputation (REP)		25%
REP1	The number of conferences organized	1000	
REP2	Partnerships with other institutions	1000	
REP3	Internship programs	500	
	TOTAL	**2500**	
7.	Sustainability (SUST)		10%
SUST1	Ratio of sustainability courses to total courses/subjects	250	
SUST2	Ratio of sustainable research funding to total research funding	250	
SUST3	The ratio between the number of scientific publications on sustainability and total teaching staff	250	
SUST4	Ecological projects implemented	250	
SUST5	Environmental responsibility awareness events	250	
	TOTAL	**1000**	

4.5. Conclusions

The purpose of this chapter was to investigate the indicators regarding the quality and performance of higher education institutions, to determine the impact of each indicator and implicitly their importance. In this sense, the current chapter focused, in a first stage, on a detailed analysis of the literature and international rankings to identify and classify the most important categories and the most important indicators that are frequently used by them. The rankings chosen were those with the highest perceived or documented impact of major relevance to this study (9 rankings). As a result, a series of indicators (49) were identified, used in the 9 international rankings analyzed.

Chapter 5. The development of an online platform/application for the calculation of indicators

5.1 Online Platform/Application Interface

The interface of the online platform/application is shown in Fig. 4.1. Its name, Romanian Universities Ranking System, is accompanied by a motto - "Performance of Romanian universities", which shows what is being pursued through this online platform/application. At the same time, at the bottom of the page, successively clarifying messages appear on what is intended to be achieved through the online platform/application.

Fig. 5.1. Online platform/application interface

Fig. 5.2 Ranking of universities within the online platform/application

Another functionality within the online platform/application is identified by the "Ranking" button. This is the area where the data of the educational institutions themselves are retrieved and processed, where the ranking of the universities is actually carried out, in 3 different scenarios (Fig. 5.2).

5.2 Ranking of universities within the online platform/application

The ranking of universities within the online platform/application is carried out following the completion of data by each university separately, data which are processed by the previously presented software/application, using both the weighted average within each category, between its indicators, but also the weighting of the values, for the 3 proposed work options.

Table 5.1 describes how to complete the indicators by each individual user.

Tab. 5.1. Description of the indicators within the online platform/application

Ind. code	Category/Indicator	Description	Formula/Text
1.	Bibliometrics (BIBL)		
BIBL1	Publications in the most cited journals	Refers to the number of publications in the Web of Science database, Nature and/or Science or other top 10% specialist publications	Text
BIBL2	Publications in prestigious journals	Refers to the number of publications that appeared in the most prestigious specialized journals	Text
2.	Education (ED)		
ED1	Teacher/student ratio	Total number of teaching staff/Total number of students	Formula
ED2	Education revenue as a percentage of total university revenue	Total university income/Total ME income	Formula
3.	Research (R&D)		
R&D1	Income from grants and research projects as a percentage of total university income	Total income from grants and research projects/Total ME income	Formula
R&D2	Research expenditure as a percentage of total university expenditure	Total research expenses/Total university expenses	Formula
R&D3	Research productivity	the total number of citations from a	Text

		calendar year will be passed	
R&D4	Services provided by the university to facilitate research/subscriptions	The total number of online database subscriptions will be passed	Text
4.	**Innovation (INOV)**		
INOV1	Patents/professors ratio	Total number of patents/Total number of teaching staff	Formula
INOV2	The number of doctoral degrees awarded	The total number of doctoral degrees awarded in a calendar year will be passed	Text
5.	**Internationalization (INT)**		
INT1	Foreign students/domestic students ratio	Total number of foreign students/Total number of domestic students	Formula
INT2	International collaborations	The total number of international partnerships concluded in a calendar year will be passed	Text
6.	**Institutional reputation (REP)**		
REP1	The number of conferences organized	The total number of conferences organized in a calendar year will be passed	Text
REP2	Partnerships with other institutions	The total number of partnerships concluded with institutions other than educational ones will be passed	Text
REP3	Internship programs	The total number of engaged internship programs will be passed	Text
7.	**Sustainability (SUST)**		
SUST1	Ratio of sustainability courses to total courses/subjects	Total number of sustainability courses/Total number of courses	Formula
SUST2	Ratio of sustainable research funding to total research funding	Total sustainable research income/Total university income from	Formula

		grants and research projects	
SUST3	The ratio between the number of scientific publications on sustainability and total teaching staff	Number of sustainability publications/Total number of teaching staff	Formula
SUST4	Ecological projects implemented	The total number of implemented projects will be passed	Text
SUST5	Environmental responsibility awareness events	The number of environmental responsibility awareness events in a calendar year will be passed	Text

5.3 Conclusions

The results obtained through the Ranking System of Romanian Universities, focusing on the processing of the indicators, but also on the database created as a result of its completion by the representatives of the universities, have a high potential value both for the rankings and for the institutions of Higher Education. Through the online platform/application, a global vision of how university rankings understand higher education institutions can be established.

As for university rankings, they can achieve a common and useful ranking process that is easy for all ranking systems to follow. If all classification systems followed the same/similar processes, higher education institutions could easily understand the classification mechanisms and provide the necessary data and answers faster and with higher quality. As for higher education institutions, they can devise strategies, prioritize publishing channels or rethink their action plans to put more emphasis on or take into account the different factors of classification systems.

Second, the transparency of the rankings provides more veracity and avoids the misconception of disregarding the interests of third parties. At the same time, better understanding of how higher education institutions are classified and evaluated could help to improve performance/universities to improve their performance.

Third, university ranking profiling is a powerful tool to understand the emphasis of ranking systems using an easy and visual representation. Moreover, ranking profiling is useful to achieve a more coherent and critical reading of ranking results, which makes the field of university rankings more reliable and valuable.
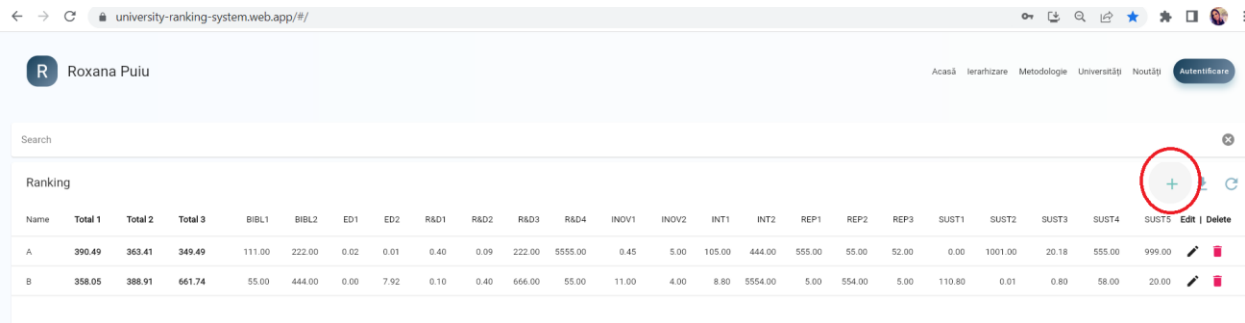
Chapter 6. Simulation and validation of the results
6.1 The use of the Calculation Application

Within the online platform/application, two models were exemplified, named generically, A and B. The exemplification was carried out, using the 3 proposed variants. In the following, we will exemplify the way to add the data of a university to the work application. Basically, the steps to be followed to enter the data in order to achieve the score for a certain university will be presented.
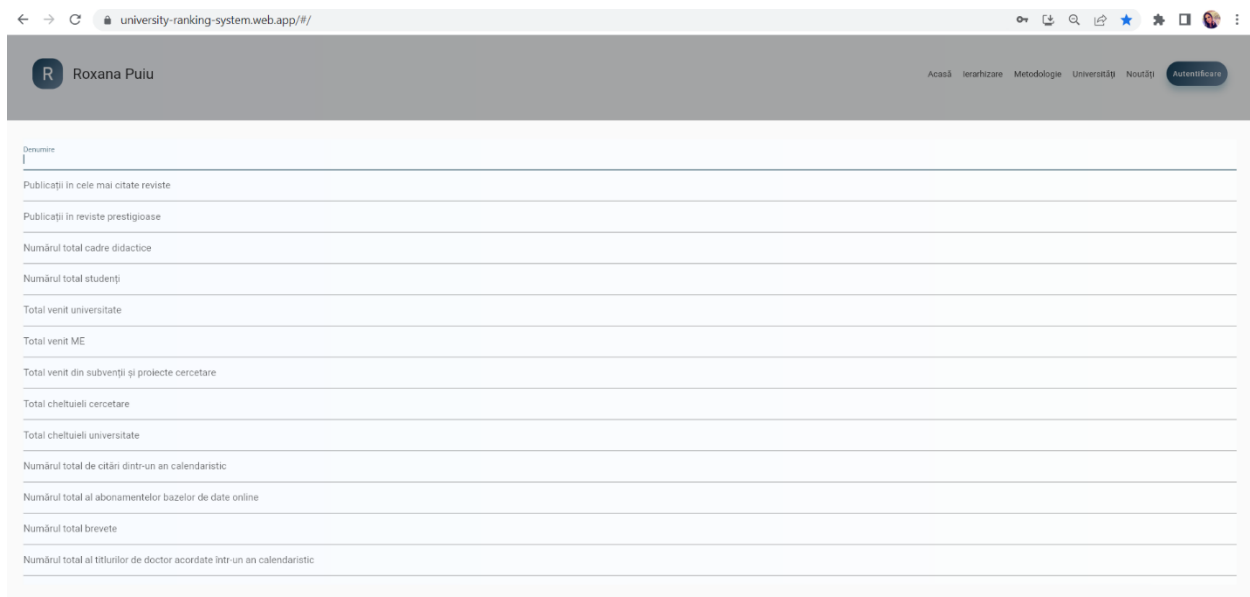
In order to be able to enter the data of a university, it is necessary that a representative of it be authenticated. This requires having an account previously created and validated by the application administrator. Basically, a university cannot enter its data more than once, and no unauthorized person can access the data entry application.

After authentication, the button named "Ranking" is accessed, and next to the page the "+" button, marked in red in Fig. 6.1.

Fig. 6.1 Adding data to the "Sort" menu

Fig. 6.2 Filling in the data in the work application

After the data loading area is launched, it is filled in manually. In Fig. 6.2, some of the fields that must be filled in are described, and in Fig. 6.3 the rest of the fields that must be filled in, as well as the buttons for making the calculation, "Submit" - marked in red and the button for resetting the data "Reset" - marked in green, as follows:

Fig. 6.3 Populating the data in the work application and launching/resetting it

After the data has been filled in and the "Submit" button has been pressed, results will be displayed for both the 3 work variants, named Total 1, corresponding to Variant 1, Total 2 for Variant 2, respectively Total 3 for Variant 3, and for each individual indicator.

Fig. 6.4 Indicator weights for Variant 1 (Total 1)

Also, if the mouse cursor is moved over the 20 indicators, the method of its calculation will be presented. There are indicators that are calculated as formulas, as shown in Fig. 6.5, but also pointers that are actually passed as input data, as indicated in Fig. 6.6.

Fig. 6.5 Calculation of the BIBL1 indicator

Fig. 6.6 REP1 Indicator

6.2. Completing the data in the calculation program

In order to be able to validate the application, real data of a university in Romania, chosen at random, were entered. The data collected refer to the university's activity carried out in the academic year 2020-2021. The University in question was named generically, University U.

Fig. 6.7 Data entry for University U

In order to enter the data, the steps explained in Subchapter 5.1 were followed, as follows: after an account was created for authentication, the data was entered in the application, as can be seen in Fig. 6.7.

Fig. 6.7 Entering data for University U (continued)

After the data were sent (Submit) in order to perform the calculation, 3 Totals resulted, as well as the 20 indicators, calculated individually. The results can be seen in Fig. 6.8:

Fig. 6.8 The results obtained in the application for University U

As can be seen in the previous figure, the best score is obtained by University U for Total 2, which mainly refers to the university research part, referring here to the area of Bibliometrics, Education, Research itself, and Innovation.

With a half score, 236.52 points, against 483.21 points, being also the lowest of the 3, is Total 1, the variant that emphasizes Sustainability. With a score close to Total 1, it is Total 3, having a value of 249.11 points. The third variant refers to the part of Internationalization and Institutional Reputation.

6.3 Conclusions

The calculation carried out in this chapter highlights the contribution that each of the 20 indicators makes in making the calculation within the application. The indicators basically contribute to the accuracy of the calculations behind the algorithm. The 3 proposed options present different scenarios that lead to extremely positive effects for university governance and, implicitly, for higher education, through the analysis carried out.

As expected, the highest score was obtained in the second Variant, which emphasizes Research (Bibliometrics, Education, Research itself and Innovation). This includes indicators with a high weight in international rankings, such as Citations and their impact (present in 7 of the 9 rankings analyzed), as well as Publications in prestigious journals (present in 6 of the 9 rankings analyzed).

The variant with the lowest score is also the variant that emphasizes Sustainability (Variant 1), a challenge for universities, with the approval of the 2030 Agenda. Courses on sustainability, ecological projects, the number of publications related to sustainable development become new targets for universities, in order to rank them in leading positions in the rankings made for universities. From here can emerge the common weakness of the current rankings, which place a low emphasis on sustainability, but also on social responsibility.

Chapter 7. Conclusions and proposals
7.1 Final conclusions

Given the changing dynamics of the world economy, the quality and status of higher education institutions and university research have become vital indicators of competitiveness. The improvement of a higher education institution is based on success in assessing quality, productivity and performance. A successful assessment helps institutions develop policies by setting goals and visions. Awareness of its importance in the academic world has led to the proliferation of studies on how to assess academic success. Consequently, new academic disciplines emerged, such as Bibliometrics, Informetrics and Scientometrics. In addition, terms and performance metrics were introduced.

In this sense, in this study, we designed a new methodology, with three variants, for the ranking of Romanian universities at the national level according to their academic performance. For the purpose of this study, we collected data from various sources to develop a ranking tool tailored to capture the quality and performance of higher education institutions in our Country.

First, our results (indicators, databases and the global view of how university rankings understand higher education institutions) have high potential value for both rankings and higher education institutions. As for university rankings, they can achieve a common and useful ranking process that is easy for all ranking systems to follow. Second, the transparency of rankings provides more veracity and avoids the misconception of respecting third-party interests. At the same time, better understanding of how higher education institutions are ranked and evaluated could help universities improve their performance.

Third, university ranking profiling is a powerful tool to understand the emphasis of ranking systems using an easy and visual representation. Moreover, ranking profiling is useful to achieve a more coherent and critical reading of ranking results, which makes the field of university rankings more reliable and valuable.

7.2. Proposals for improving the visibility of higher education institutions in Romania

These proposals for improvements in the international rankings mainly focus on: (1) the necessary indicators for social responsibility, ethics and sustainability, but at the same time; (2) the need for transparency in the rankings and (3) the necessary measures to be taken by each institution of higher education in Romania in order to access and remain in the international rankings occupying better and better positions.

To help rankings introduce new indicators of social responsibility, ethics and sustainability, we propose a list of possible ranking indicators:
- Students with disabilities or vulnerabilities;
- Projects with NGOs and social economies;
- Voluntary activities;
- Projects in developing countries;
- Inclusion of ethics, morality, social economies, social responsibility and sustainability in courses or programs;

- Use of open source resources;
- Open use of data / information;
- Recycling / reuse, e-waste, energy plans;
- The student's family income.

Among the necessary measures to be taken by each higher education institution in Romania in order to access and remain in the international rankings occupying increasingly better positions, we mention:

1. Elaboration of a service system or portal to provide ranking information to higher education institutions in Romania

2. Preparing an open data service for higher education institutions in Romania

3. Using ranking information to define university positioning strategies

4. The use of indicators of university rankings for the improvement and design of curricula by subjects and cycles of higher education

5. Using the profiling of university rankings to improve institutional and international relations

7.3. Original contributions

1. Comparative critical analysis of 9 international rankings, the most well-known and having significant relevance, as well as the complex system of classification and ranking of higher education institutions - U-multirank initiated by the European Commission.

2. Carrying out a detailed research of the literature to identify all the indicators that are used in the nine international rankings analyzed in the paper, through the critical review of the scientific literature and the methodologies of the international rankings. (Google Scholar and Web sites rankings and methodology).

3. Centralization of the most frequently used indicators in the international rankings by reviewing the weights and occurrences of the indicators in the international rankings.

4. Critical analysis of the proposed methodologies for the classification of Romanian universities

5. Analysis of the dynamics of the ranking of Romanian universities at the international level in 7 rankings.

6. The centralization of the rankings of Romanian universities at the national and international level and the analysis of the most prestigious universities in Romania according to the international rankings.

7. Prioritization of the indicators from the international rankings through the AHP technique and their centralization according to the weights obtained (3 variants).

8. At the same time, since our analysis showed that the most used criteria by the international rankings are: Sustainability (SUST), Bibliometrics, (BIBL), Education (ED), Research (R&D), Innovation (INOV), Internationalization (INT) and Institutional Reputation (REP), in the conclusions, policies, strategies, initiatives and programs were highlighted that we

believe must be implemented for each category separately, so that Romanian universities can secure a position in international rankings.

In this sense, the originality of the research also lies in the fact that the presented methodology and models can be made available to government institutions and can serve as a basis for the general ranking and evaluation of higher education institutions with the possibility of developing a performance-based financing system. In addition, other involved stakeholders may have an insight into the performance of an institution for the sake of their own needs and goals, whether we mean students, business or other parties.

7.4. Future research directions

There are aspects that have been left out of scope in this paper for future studies. First, the three methodologies proposed for the new classification system can be developed by adding new indicators and modifying the existing ones to propose a ranking system focused on other categories or involving other weights. Furthermore, the classification of institutions by fields, faculties or disciplines can be another future study. Thus, institutions could be compared according to their specialized fields, not as a whole. We therefore propose the following research directions:

1. The use of a business intelligence system for higher education institutions in Romania;

2. The classification of all institutions of higher education can be done at the state level, based on the proposed model, and a national system of classification of institutions of higher education can therefore be suggested.

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