

# Three Decades of Scientific, Technological Research and Creative Innovation at Vietnam National University, Hanoi: A Comprehensive Examination (1993-2023)

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**Nguyen Hoang Son<sup>1</sup>, Le Ba Lam<sup>1\*</sup>, Nguyen Thi Kim Lan<sup>2</sup>, Tran Thi Khanh Van<sup>2</sup> and Trinh Khanh Van<sup>2</sup>**

<sup>1</sup>*Library and Digital Knowledge Center, Vietnam National University, Hanoi*

<sup>2</sup>*University of Social Sciences and Humanities, Vietnam National University, Hanoi*

**\*Corresponding Author:** Le Ba Lam, Library and Digital Knowledge Center, Vietnam National University, Hanoi.

## Abstract

Since its inception on December 10, 1993, when it was decreed by the Prime Minister, Vietnam National University, Hanoi (VNU) has had a substantial impact on higher education in Vietnam for the past three decades. At present, VNU has developed into a thriving center for education and research, with 37 members and connected units. These include 16 service units, 9 universities, 4 affiliated schools, 6 research institutes, 2 training and research centers, and 2 institutes of higher education. This paper presents an exhaustive examination of the research outputs of VNU spanning the years 1993 to 2023. It emphasizes the university's significant contributions to the Scopus Database, which contains more than 10,000 document records, and the Web of Science Database, which contains more than 9,100 records. The research study thoroughly examines the statistical data and analyses pertaining to these outputs, considering many factors including number, quality, subjects, authors, and collaborations. This report presents an exhaustive assessment of the research outputs of VNU spanning a period of thirty years. It emphasizes the efficacy of institutional measures in bolstering scientific production and fostering innovation.

**Keywords:** Bibliometric analysis; Scientific research; Creative Innovation; Research outputs; Policy impact

## Introduction

In the evolving landscape of global education and research, universities play a pivotal role as catalysts for scientific advancement and innovation. Vietnam National University, Hanoi (VNU), in this regard, stands as a prominent example of an institution driving significant change in higher education and research within Vietnam. This paper aims to critically evaluate the impact and efficacy of VNU's strategic initiatives, particularly in the realm of scientific research, technology, and innovation "(DH-QGHN, 2022).

March 29, 2021, marked a significant milestone in VNU's journey towards academic excellence with the issuance of Decision No. 800/QĐ-DHQGHN by the Director of VNU. This decision laid out the Development Strategy of VNU to 2030, envisioning further progress up to 2045. This strategy, building upon the accomplishments and learning from the limitations of previous years, aligns with the national directives on educational and technological innovation outlined in the Central Resolution. It also resonates with the objectives set forth in the VI Party Congress Resolutions of VNU, focusing on enhancing the university's role and status in the context of Vietnam's overall development (DHQGHN, 2022, 2021). Emphasizing a forward-looking approach, this strategy delineates a comprehensive plan to bolster VNU's contributions to scientific research and technological progress. The strategic plan not only encapsulates the aspirations of VNU to elevate its global academic standing but also reflects a commitment to addressing contemporary challenges through innovation and research.

Considering these strategic developments, this paper presents an in-depth analysis of VNU's research outputs from 1993 to 2023, underscoring the university's growing influence in the scientific community. The study utilizes bibliometric methodologies to examine approximately 11,000 papers from the Scopus and Web of Science databases, offering insights into the breadth and depth of VNU's research impact. This exploration is not just an academic exercise but a testament to the effectiveness of VNU's strategic planning and execution in the domain of scientific research and innovation.

<b>Members</b>	<b>Name of English</b>
HUS	VNU - University of Science
USSH	VNU - University of Social Sciences and Humanities
ULIS	VNU - University of Languages and International Studies
UET	VNU - University of Engineering and Technology
UEB	VNU - University of Economics and Business
UEd	VNU - University of Education
VJU	VNU - Vietnam Japan University
UMP	VNU - University of Medicine and Pharmacy
UL	VNU - University of Law
HSB	VNU - School of Business and Management
IS	VNU - International School
SIS	VNU - School of Interdisciplinary Studies
IFI	VNU - International Francophone Institute
ITI	VNU - Information Technology Institute
CRES	VNU - Institute of Natural Resources and Environmental Studies
IMBT	VNU - Institute of Microbiology and Biotechnology
IVIDES	VNU - Institute of Vietnamese Studies and Development Sciences
TNTI	VNU - Tran Nhan Tong Institute
INFEQA	VNU - Institute for Education Quality Assurance
LIC	VNU - Library and Digital Knowledge Center
CEA	VNU - Center for Education Accreditation
CET	VNU - Center for Educational Testing
HOS	VNU - Hospital
CPES	VNU - VNU National Defense and Security Training Center
CSK	VNU - Centre for Knowledge Transfer and Start-up Support

CDH	VNU - Human Resource Development Center
SERVICE	VNU - Service Units

**Table 1:** Members VNU's.

## Literature Review

Bibliometric approach is a typical research instrument for systematic analysis and have been used to quantify scientific progress in many disciplines of science and engineering (A. F. J. Van, 2005). Many scientists have attempted to evaluate the research trends in the publication outputs of countries, research institutes, journals, and subject categories (J. Garcia-Rio, F. Serrano, S., Dorgham, A., Alvarez-Sala, R., Pena, A.R., Pino, J.M., Alvarez Sala, 2001) (C. Z. Zhou, F. Guo, H.C., Ho, 2007), the citation analysis (Cole, 1989), and the peak year citation per publication (Y. S. Chuang, K.Y., Huang, 2007) (Y. S. Li, 2008) since Narin et al. (H. H. Narin, F. Pinski, 1976) first proposed the concept of "evaluative bibliometrics." Many articles on these themes are published online in Vietnam, with topics such as "Vietnam's research output in the last 5 years.", "Taking attendance at 30 Vietnamese universities with the most research outputs" or "Vietnam has more than 17,000 international articles published in 2020" (Hung, 2020), but none of these are included in the analysis in the possible units.

VNU and VNUHCM (Vietnam National University, Ho Chi Minh) are two universities that receive special attention and investment from the state. In addition to training high-quality human resources, fostering talents, investing in scientific research, specifically research outputs is a particularly important task. Therefore, annual statistics, analysis and evaluation of research outputs indicators are essential so that management leaders can make correct and appropriate decisions.

## Objectives

The primary objectives of this paper are to provide a comprehensive analysis of the research outputs of Vietnam National University, Hanoi from 1993 to 2023, focusing on:

- 1. Quantitative and Qualitative Analysis:** Assessing the quantity, quality, document types, subjects, authors, citations, and source titles of approximately 11,000 documents, reflecting the breadth and depth of VNU's research over 30 years.
- 2. Alignment with Strategic Goals:** Evaluating how the research outputs align with VNU's strategic goals and vision. This entails analyzing the extent to which these products support VNU's overarching objective of cultivating scholarly distinction, inventive thinking, and technical progress.
- 3. Impact on Innovation and Technology:** Investigating the role of VNU's research in driving innovation and technological advancements, both within the academic community and in broader societal contexts.
- 4. Societal and Academic Influence:** Analyzing the broader impact of VNU's research on societal development, policy-making, and industry collaborations. This will need evaluating the impact that research outcomes have on the formation of public policies and the advancement of social welfare.
- 5. Interdisciplinary Research Collaboration:** Exploring the extent of interdisciplinary collaboration and knowledge sharing facilitated by VNU's research outputs, and how this fosters a multidisciplinary approach to addressing complex global challenges.
- 6. Benchmarking and Comparative Analysis:** Comparing VNU's research outputs with other similar institutions, both within Vietnam and internationally, to contextualize VNU's achievements and identify areas for future growth.
- 7. Future Research Directions:** Identifying emerging research trends, potential gaps, and future trajectories based on the analysis of VNU's past and present research outputs. This will aid in strategic planning and setting directions for future research initiatives at VNU.
- 8. Methodological Contributions:** Exploring innovative methodologies in bibliometric analysis that can be applied to the assessment of academic research outputs, thereby contributing to the field of research evaluation.

The primary purpose of these objectives is to underscore the noteworthy accomplishments of VNU in the field of scientific and technical investigation. Additionally, they seek to lay the groundwork for forthcoming advancements and innovations in these areas, thereby strengthening VNU's position as a preeminent research establishment.

## Methodology

The methodology adopted in this study is designed to systematically analyze the research outputs of Vietnam National University, Hanoi (VNU) over a thirty-year period, using a combination of bibliometric and data analysis techniques. The following steps outline the methodology:

1. **Data Collection:** Research outputs were collected from two major academic databases: Scopus and Web of Science (WoS). An affiliation search was conducted for VNU (ID: 60071364 in Scopus, and OG = Vietnam National University Hanoi in WoS) for the period from 1993 to 2023.
2. **Data Extraction:** The search parameters were set to include publications from the year 1993 to 2023, ensuring a comprehensive capture of research outputs over the thirty-year period. This yielded a dataset of approximately 11,000 papers.
3. **Data Analysis Tools:** To analyze the dataset, we utilized a suite of analytical tools:
  - RStudio and BiblioShiny: For data cleaning, organization, and preliminary analysis.
  - VOSViewer: For creating network maps and identifying research trends and patterns.
  - Excel: For managing and manipulating data sets and performing basic statistical analyses.
  - Scival (Elsevier) and InCites (Clarivate Analytics): For advanced bibliometric analysis, including citation analysis and impact assessment.
4. **Data Processing:** The data was processed to remove duplicates (papers indexed in both Scopus and WoS), ensuring accuracy in the count and analysis of publications.

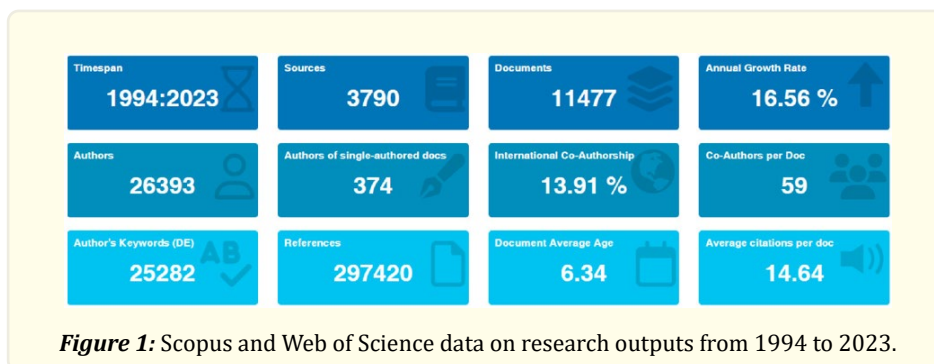
By employing this comprehensive methodology, the study aims to provide a detailed and accurate assessment of VNU's research outputs, their impact, and their alignment with the institution's strategic goals.

## Data Analysis

### *Overview of VNU's research outputs (1993-2023)*

This analysis focuses on the research contributions of VNU's staff, lecturers, researchers, and students, as indexed in the Scopus and WoS databases. The period studied spans from 1994 to September 30, 2023, yielding a comprehensive dataset:

- 11,477: Documents;
- 3,790: Sources (Magazines, book series, conference proceedings, and seminars are selected for publication by the authors);
- 16,56%: Annual Growth Rate;
- 26,393: Authors;
- 374: Authors of single-authored docs;
- 13,91%: International Co-Authorship;
- 59: Co-Authors per Doc;
- 14,64: Average citations per doc;
- 6,34: Document Average Age (The articles were mainly published in the last 12 years, most in the last 6 years).



**Figure 1:** Scopus and Web of Science data on research outputs from 1994 to 2023.

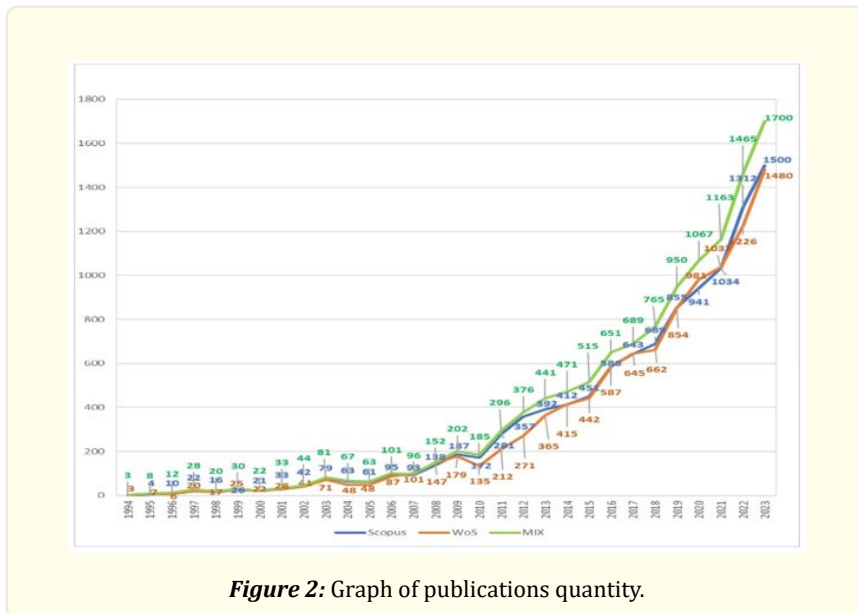
### Quantity and Growth Trends

After removing duplicate works (documents from the same source but indexed by both the Scopus and WoS databases), the Scopus database contains over 10,000 works and the WoS database contains over 9,100 works. Table 1 shows the specifics for each year.

<b>Year</b>	<b>1994</b>	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>
Scopus	0	4	10	22	16	26	21	33	42	79
WoS	3	7	6	20	17	25	22	28	41	71
MIX	3	8	12	28	20	30	22	33	44	81
<b>Year</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>
Scopus	63	61	95	93	138	187	172	281	357	392
WoS	48	48	87	101	147	179	135	212	271	365
MIX	67	63	101	96	152	202	185	296	376	441
<b>Year</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>2021</b>	<b>2022</b>	<b>2023</b>
Scopus	412	451	586	643	689	855	941	1034	1312	1500
WoS	415	442	587	645	662	854	981	1037	1226	1480
MIX	471	515	651	689	765	950	1067	1163	1465	1700

**Table 2:** Annual number of publications.

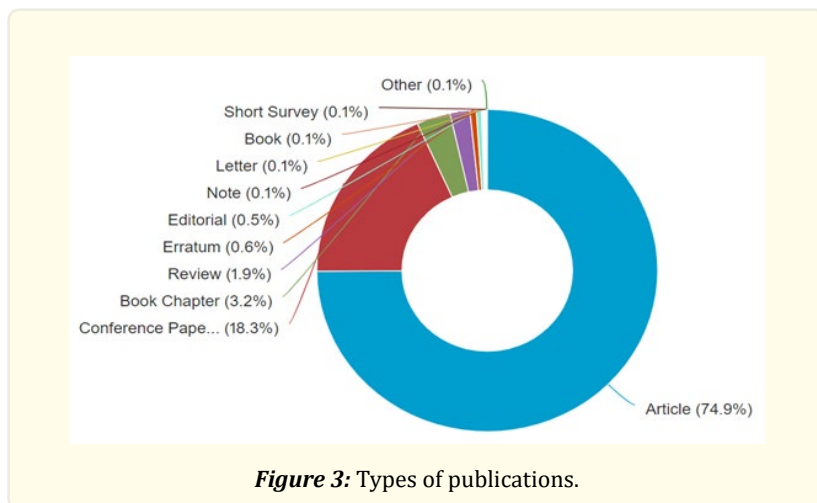
In 1994, VNU scientists began publishing their initial research on the WoS system. In the years that followed, the number of publications increased annually, albeit at a negligible rate, and this trend persisted until 2005. During this ten-year period, a minor change occurred. In 2002, there were 44 publications; in 2003, there were 81 publications (a doubling); however, in 2004 and 2005, the number of publications decreased once more to 67 and 63, respectively. The year 2006 was notable because it marked the first time that more than 100 publications were published. The number of publications increased in a sinusoidal pattern until 2011, when it stopped increasing and decreased annually. Between 2011 and 2019, the number of publications increased annually to around 100, achieving a high slope of more than 40 degrees.



More than 1,000 publications were published in 2020, marking a significant milestone. There will be an approximate 15% annual growth in the three years 2021-2023; in 2023 (until the end of September), there will be approximately 1,200 publications; based on the figures and presentation above, the average annual growth over the 30-year period is 16.56%.

**Diverse Research Outputs**

Fig 3. Types of publications The majority of published papers (74.9%) are magazine articles, followed by articles from conferences and seminars (18.3%), book chapters (3.2%), and reviews (1.9%). Erratum, Editorial, Note, Letter, Book, Short Survey, and other categories account for less than 1% of all submissions.



### Authorship and Collaboration

VNU has 37 member units and affiliated units, according to the VNU annual report for 2022, including 9 universities, 3 schools and faculties, 7 research institutes, 2 training and research centers, and 16 service and service units. There are 2,634 scientists among the 4,754 total personnel.

According to statistics and data analysis from research outputs, there are approximately 2,800 Vietnamese staff, lecturers, researchers, and students working at VNU with international publications, of which 1,642 are male and 1,156 are female. The authors address 27 member units and affiliated units in this total number of publications. Data show that the diverse research activities of professors and students, as well as the fact that two-thirds of the units have international publications, is the result of not only member universities and research institutes, but also service units. Most units have an equal gender distribution of scientists, with the exception of the University of Engineering and Technology and the University of Law, which have 2/3 male and 1/3 female scientists, and VNU - Institute of Microbiology and Biotechnology, which has 1/3 male and 2/3 female scientists.

<i>Units</i>	<i>HUS</i>	<i>UET</i>	<i>UEB</i>	<i>USSH</i>	<i>UMP</i>	<i>IS</i>	<i>Ued</i>	<i>ULIS</i>	<i>VJU</i>	<i>IMBT</i>	<i>UL</i>	<i>CRES</i>	<i>ITI</i>	<i>SIS</i>
Male	654	461	97	87	67	43	41	23	29	8	20	17	24	11
Female	545	130	102	86	56	38	39	51	22	23	10	11	1	13
Total	1199	591	199	173	123	81	80	74	51	31	30	28	25	24

**Table 3a:** Number of articles published by respective units.

<i>Units</i>	<i>OFFICE</i>	<i>HSB</i>	<i>IFI</i>	<i>LIC</i>	<i>INFEQA</i>	<i>IVIDES</i>	<i>CEA</i>	<i>TNTI</i>	<i>CET</i>	<i>HOS</i>	<i>CPES</i>	<i>CSK</i>	<i>CDH</i>
Male	15	10	11	6	3	5	1	3	2	2	1	0	1
Female	2	6	3	4	5	2	4	0	1	0	1	1	0
Total	17	16	14	10	8	7	5	3	3	2	2	1	1

**Table 3b:** Number of articles published by respective units.

This article divides the total number of published works by authors into two phases: phase 1 (from 1994 to 2012) and phase 2 (from 2013 to the present). The table below lists the top ten authors by number of publications.

<i>1994 to the present</i>				<i>2013 to the present</i>			
<i>No.</i>	<i>Author</i>	<i>QTY</i>	<i>Units</i>	<i>No.</i>	<i>Author</i>	<i>QTY</i>	<i>Units</i>
1	Pham Hung Viet	204	HUS	1	Nguyen Mau Chung	570	HUS
2	Nguyen Dinh Duc	176	UET	2	Le Hoang Son	231	ITI
3	Nguyen Huu Duc	91	UET	3	Le Duc Minh	127	HUS
4	Pham Chi Vinh	80	HUS	4	Chu Duc Trinh	102	UET
5	Ha Quang Thuy	74	UET	5	Tu Binh Minh	100	HUS
6	Nguyen Huu Du	65	HUS	6	Nguyen Linh Trung	99	UET
7	Nguyen Chau	63	HUS	7	Bui Thanh Tung	91	UET
8	Nguyen Hoang Luong	62	HUS	8	Chu Dinh Toi	84	IS
9	Bui The Duy	58	UET	9	Tran Xuan Tu	82	ITI
10	Bach Thanh Cong	51	HUS	10	Tran Quang Tuyen	72	IS

**Table 4:** The top ten authors by number of publications in two phases.



According to Table 4, phase 1 consists of research contributions and publications from the Universities of Science and University of Engineering and Technology (6/4). The authors are well-known professors and researchers who have been involved in the field since VNU's inception. The majority of well-known scientists, including professors, come from basic science fields such as biology, chemistry, physics, mathematics, and environmental science. Prof. Nguyen Chau, Nguyen Hoang Luong, Nguyen Phu Thuy, Pham Chi Vinh, Nguyen Huu Du, Bach Thanh Cong, Nguyen Huu Duc, Nguyen Dinh Duc, and others are among them. Phase 2 has strong contributions from younger researchers such as Assoc. Prof. Le Duc Minh, Assoc. Prof. Tu Binh Minh (University of Science), Prof. Chu Duc Trinh, Assoc. Prof. Nguyen Linh Trung, Assoc. Prof. Bui Thanh Tung (University of Engineering and Technology), Assoc. Prof. Le Hoang Son, Assoc. Prof. Tranh Xuan Tu (The Information Technology Institute), Assoc. Prof. Tran Quang The analysis highlights the collaborative nature of research at VNU, with significant international co-authorship. It also reveals an equitable gender distribution in most research units. The contribution of young researchers in recent years is particularly noteworthy, indicating a successful generational transition in research leadership.

According to the VNU annual report for 2022, the institution consists of 37 member units and associated units. These comprise 16 service and service units, 9 universities, 3 schools and faculties, 7 research institutions, and 2 training and research centers. Scientists comprise 2,634 of the total 4,754 staff.

Based on statistical analysis and research output data, VNU employs an estimated 2,800 Vietnamese personnel, including lecturers, researchers, and students, some of whom have authored works on an international level. Among this number, 1,642 are male and 1,156 are female. A total of 27 member units and linked units are discussed by the authors in this collection of works. The diversified research activities of faculty and students, in addition to the fact that two-thirds of the units have international publications, are the products of service units in addition to member universities and research institutes, according to the data. The majority of scientific units exhibit a gender-balanced composition, except for the University of Engineering and Technology, the University of Law, and VNU-Institute of Microbiology and Phase 1 comprises research contributions and publications from the Universities of Science and Engineering and Technology, as shown in Table 3 (6/4). Professors and researchers of renown who have been active in the field since VNU's foundation comprise the authors. Professors and the majority of renowned scientists emerge from disciplines within the realm of fundamental sciences, including environmental science, chemistry, physics, biology, and mathematics. They include, among others, Nguyen Chau, Nguyen Hoang Luong, Nguyen Phu Thuy, Pham Chi Vinh, Nguyen Huu Du, Bach Thanh Cong, Nguyen Huu Duc, and Nguyen Dinh Duc. Younger researchers, including Associate Professors Le Duc Minh and Tu Binh Minh (both from the University of Science), Chu Duc Trinh, Nguyen Linh Trung, Bui Thanh Tung (all from the University of Engineering and Technology), Le Hoang Son, Tranh Xuan Tu (all from The Information Technology Institute), Tran Quang Tuyen, Ph.D Chu Dinh Toi (International School), and Bui Thanh Tung, have made significant contributions to Phase 2.

Prominent scientists who established VNU, such as the late Prof. and Academician Nguyen Van Dao, Prof. and Academician Nguyen Van Hieu, and Prof. Nguyen Xuan Han, have been inducted. Additionally, it is important to acknowledge the professors who have made significant contributions to the advancement of scientific knowledge "over two centuries." Prominent scientists who have made such contributions include Prof. Pham Thi Tran Chau, Nguyen Lan Dung, Vo Quy, Vu Trung Tang, Phan Tong Son, Nguyen Huu Cong,... (HUS); the late Prof. Tran Quoc Vuong; Prof. Phan Huy Le; Assoc. Prof. Truong Thi Khanh Ha; Prof. Young scientists Nguyen Huu Duy, Nguyen Ngoc Minh, Hoang Quoc Anh, Pham Thanh Luan, Dang Kinh Bac,... (HUS), Nguyen Thu Trang, Nguyen Thu Huong, Nguyen Van Luot, Lam Minh Chau (USSH), Nguyen An Thinh (UEB), and Nguyen Duc Khuong have recently published numerous annual papers (IS). The thriving scientific research landscape at VNU has been enriched by one or more contributions from authors of all generations throughout the past three decades.

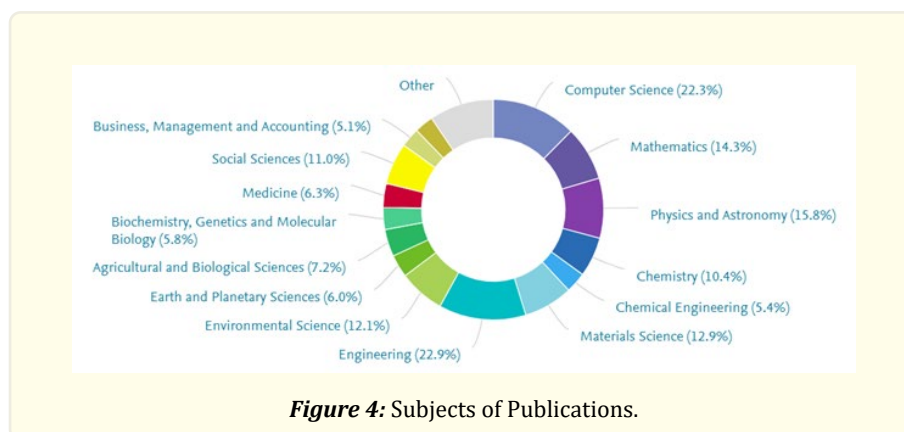
### ***Subject Matter Analysis***

VNU's publications cover a wide array of subjects, aligning with its multidisciplinary nature. Key areas include Engineering, Computer Science, and Physics and Astronomy, which collectively constitute a significant portion of VNU's research focus. This aligns with VNU's strategic emphasis on science and technology. Over the past five years, VNU, being a multidisciplinary and multi-field institution,



has established an abundance of novel research and training domains. Subsequently, there has been a proliferation and diversification of scientific research subjects and foreign publishing, as evidenced by the comprehensive coverage of 27 scientific topics by Elsevier. Approximately 3,000 minor themes and almost 800 main subjects are addressed in publications and research.

A growing number of high-quality publications in basic science subjects such as mathematics, physics, chemistry, science and technology, applied science, and medicine are being produced. Social science and humanities, arts, and interdisciplinary science are all growing in popularity. Language, economics, and law studies are currently being emphasized and promoted.



The specialized fields of each unit are shown through data:

22,9%: Engineering;

22,3%: Computer Science;

15,8%: Physics and Astronomy;

14,3%: Mathematics;

12,9%: Materials Science;

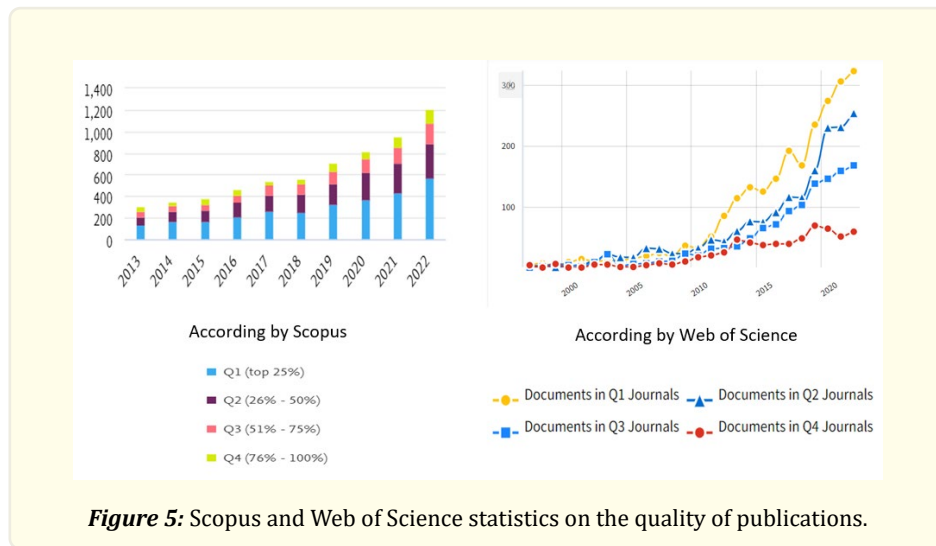
12,1%: Environmental Science;

10,4%: Chemistry.

Science and technology publications account for 70.4% of all publications. The outcome is completely consistent with the research traditions and strengths in basic and applied science of member units and affiliated units such as the University of Sciences, the University of Engineering and Technology, The Information Technology Institute, the Central Institute for Natural Resources and Environmental Studies, and the Institute of Microbiology and Biotechnology. In 2022, research and publications in social science, humanities, and arts advanced (to 11.85%), outperforming the 11.07% performance in economics and law. The medicine sector, with a 6.3% contribution, is steadily developing and expanding VNU's health sciences.

### **Research Quality**

The level of excellence of VNU's research efforts is one of its strongest points in international publications. According to statistics spanning a decade, the quality of publications in Q1 and Q2 has consistently been above 70% (74.3% - Publication share).



The following table contains statistics and analysis of publication quality for the 10-year period 2010-2020 based on VNU training units and research institutes:

No.	Units	Q1		Q2		Q3		Q4		N/A	
		Scopus	WoS	Scopus	WoS	Scopus	WoS	Scopus	WoS	Scopus	WoS
1.	HUS	1056	1051	822	796	383	340	136	90	318	242
2.	USSH	63	56	30	31	15	9	5	4	46	77
3.	ULIS	10	13	15	14	8	5	3	4	20	39
4.	UET	272	261	334	273	94	71	69	35	684	482
5.	UEB	41	41	74	55	74	32	19	13	27	20
6.	UEd	83	73	102	96	52	43	32	14	74	33
7.	VJU	65	38	34	31	12	4	7	4	12	5
8.	UMP	65	68	54	47	28	23	8	2	11	10
9.	UL	2	2	6	6	1	0	3	1	7	9
10.	HSB	2	2	3	3	6	2	0	0	3	0
11.	IS	28	28	20	23	13	9	16	10	16	29
12.	IFI	1	1	14	12	3	2	5	3	24	30
13.	SIS	3	3	2	2	0	0	0	0	3	2
14.	IVIDES	1	1	3	3	0	0	0	0	0	1
15.	IMBT	12	11	8	7	5	6	3	0	3	3
16.	INFEQA	0	0	0	0	0	0	1	0	0	4
17.	ITI	64	64	52	49	12	11	7	3	28	29
18.	CRES	34	35	45	44	22	22	3	1	9	5

**Table 5:** Quality of Publications by Unit in the Scimago Category.

According to Table 5, the publication quality of the units can be divided into three categories: high quality, quality ( $Q1+Q2 > 100$ ), and medium quality:

- Group 1: University of Sciences, University of Engineering and Technology.
- Group 2: University of Social Sciences and Humanities, University of Education, University of Economics and Business, Vietnam Japan University, University of Medicine and Pharmacy and The Information Technology Institute.
- Group 3: Units remaining.

In terms of average growth, the number of publications increased by 22% on average in the first and second quarters of this ten-year period; the two years 2010 and 2011 saw the highest increase, at a rate of 80%. Three years are 36% in 2015 and 2016, and 32% in 2018 and 2019.

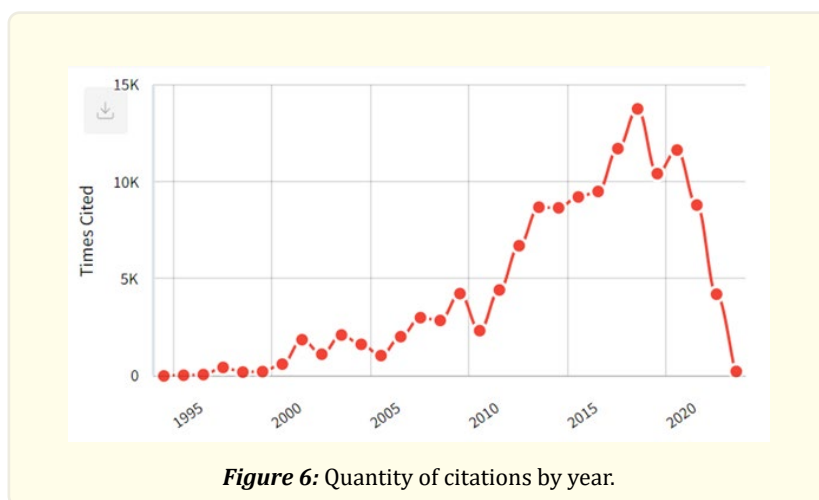
During this time period, the growth rate for publications in the third and fourth quarters is 25%, which is 3% higher than the rate for the first and second quarters. The highest rate of growth is seen in 2011 and 2012, when it is 74%; in 2012 and 2013, it is 75%; and in 2019 and 2020, it is 29%.

### **Citation Analysis**

In addition to reflecting the practical application, the quantity of citations also signifies the caliber and status of scientific work dissemination. Typically, for a publication to amass a substantial quantity of citations, it is imperative that it is accessible to scholars and has elapsed an adequate duration since its first publication. In recent years, however, as a result of the increased accessibility of papers made possible by digital publishing, citations have been updated more efficiently to more precisely reflect the research's key conclusions.

The number of citations reflects not only the practical application, but also the level and quality of scientific work dissemination. In general, in order to receive a large number of citations, a publication must be approachable to researchers and have a sufficient amount of time since publication. However, regarding digital publishing has made publications more accessible to readers in recent years, citations have been updated more efficiently to accurately reflect the research's main findings.

VNU has nearly 150,000 (149,105) citations in 30 years, with over 10,000 publications (10,091). The average number of citations is nearly 14.0.



Recent publication of the work with the highest number of citations (2018) has garnered close to 4,000 citations. The 2009 publication with the second-highest citation count, accumulated by roughly 1,874 citations, was authored by Professor Pham Hung Viet of the University of Sciences' Center for Environmental Technology and Sustainable Development Research (CETASD-HUS). The third publication, which included Chu Dinh Toi from the International School Center for Biomedicine and Public Health, was released in 2021 and has amassed more than a thousand citations.

Based on the information presented in Table 6, 2,283 articles are devoid of any citations, 7,596 publications have received citations ranging from 1 to 100 times, 159 publications have been cited 100 to 200 times, and 25 publications have been cited 200 to 300 times.

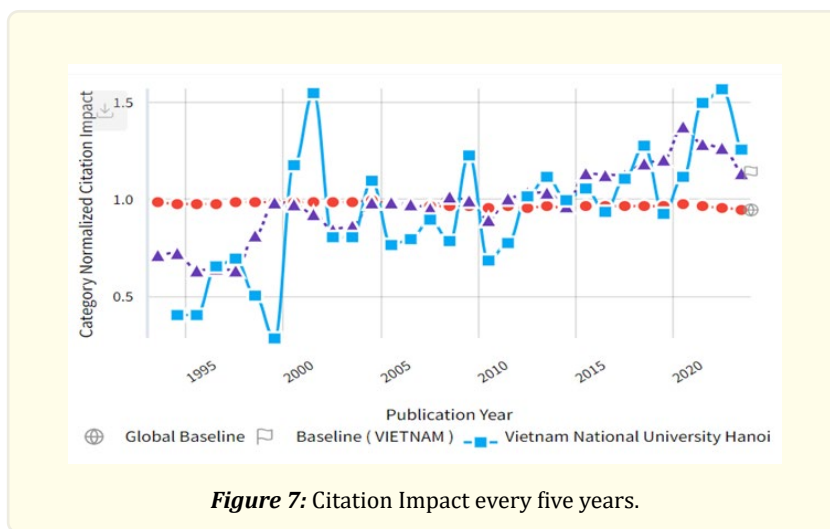
No citation	1-100 times	100-200 times	200-300 times	300-400 times	400-500 times	500-600 times	600-700 times	700-900 times	More 1000 times	Approximately 4000 times
2.283	7.596	159	25	12	8	2	2	2	2	1

**Table 6:** Statistics on the number of publications and citations.

1996-2000	2001-2005	2006-2010	2011-2015	2016-2020	2021	2022	2023
11	39	79	231	452	205	504	757

**Table 7:** The total number of uncited works in the previous three years, as well as every five years.

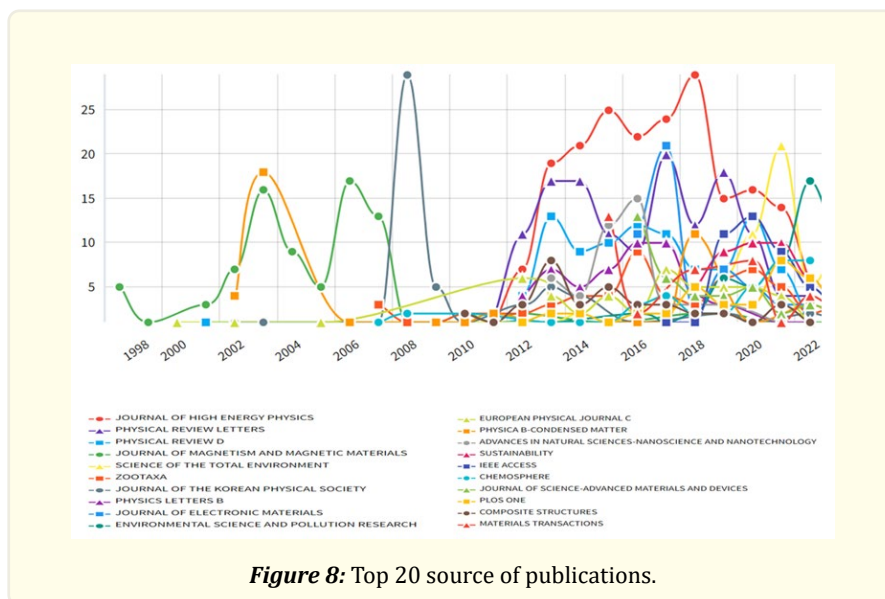
Between 1996 and 2015, there were 360 uncited publications, or approximately 16% of the total, which is negligible (Table 7). An estimated 20% of articles that are to be published from 2016 to 2020 will necessitate further review and evaluation of the quality of the study. Approximately 64% of the research must undergo assessment by scientists and researchers prior to being cited. This consists of studies conducted within the previous three years. For research to be regarded as high-quality and frequently mentioned, it is crucial to have a coordinated communication system and other supporting tools in place, in addition to concentrating on publication in prominent journals.



**Figure 7:** Citation Impact every five years.

**Publication Sources**

VNU authors have published over 11,000 articles in 3,790 journals, proceedings, and book chapters. Figure 8 depicts the top 20 sources from which the researchers chose to publish their findings.



### Collaboration Efforts

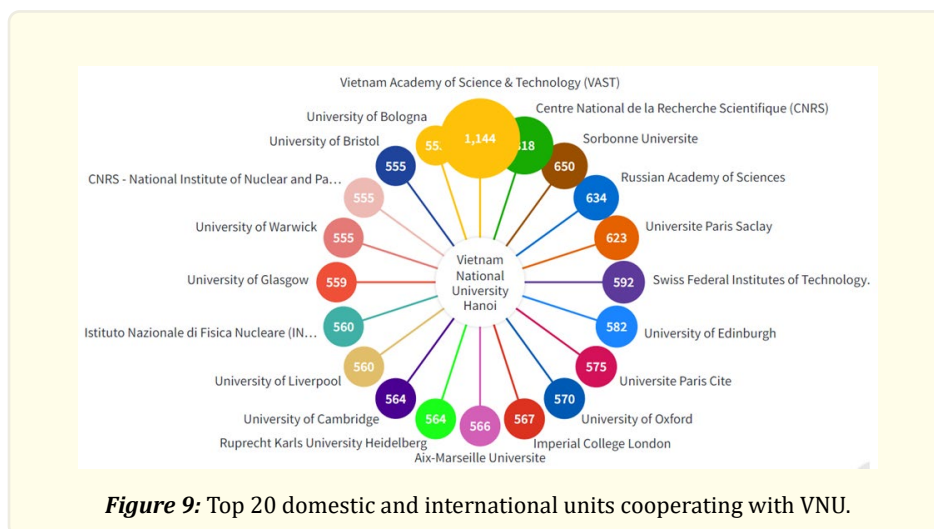
VNU's collaborative research spans across domestic and international borders, underlining its commitment to global academic engagement and knowledge exchange. Students, faculty, researchers, and staff at VNU have conducted joint research with more than 20,000 domestic and foreign scientists and approximately 3,000 domestic and international organizations and units during the past three decades. International collaboration comprises 67% of research, domestic collaboration comprises 26%, and individual research comprises 6%. This illustrates VNU's commitment to and emphasis on research collaboration.

Domestic units that have been most cooperative in terms of collaboration with the author's study at VNU include:

- Vietnam Academy of Science and Technology.
- Hanoi University of Science and Technology.
- Ton Duc Thang University.
- Hanoi National University of Education.
- Hanoi Medical University.
- Phenikaa University.
- Vietnam National University, Ho Chi Minh City.

Two universities that get government funding and support are VNU and VNUHCM. Over the past three years, VNUHCM has exhibited superior performance in several international research projects and publications when compared to the Vietnam Academy of Science and Technology. There has not been much scientific collaboration between the two national universities in recent years. Moving forward, further collaboration between the two universities is required to advance worldwide publication and scientific research.

Furthermore, in comparison to domestic units, VNU's international collaboration is larger and more diverse, encompassing countries such as the United States, France, Germany, Russia, the Netherlands, and Japan (Figure 9).



### **Methods for increasing research outputs**

At the annual Science, Technology, and Innovation Conference on June 15, 2023, the administration of VNU unveiled several innovative policies intended to augment the quantity and caliber of scientific endeavors as well as international publications. These policies comprise the following: allocation of funds towards substantial research facilities, robust research teams, and laboratories; provision of financial assistance for international publications; promotion of young researchers; and recruitment of exceptionally skilled scientists to join the VNU faculty.

To achieve the goals, the following specific solutions are proposed in this article:

- 1. Complete policy mechanisms for managing science, technology, and innovation activities** in order to increase research quantity and quality. This solution prioritizes policies to attract high-quality human resources, including core and leading scientists. This human resource policy is consistent with the goals of inspiring, supporting, and funding young talented scientists, strong research teams, and significant laboratories.
- 2. Strengthen bilateral and multilateral cooperation** and co-invest in major international cooperation initiatives with partners. Encourage even more research collaboration with regional universities and the Vietnam National University in Ho Chi Minh City, which has published numerous studies on sustainable development in the last three years.
- 3. Promote partnerships with companies** and local economies to commercialize research findings and technologies that directly contribute to socioeconomic development; and cultivate an innovation ecosystem in the areas of science and technology transfer and research.
- 4. Focus on basic science, applied science and technology**, interdisciplinary research, and subjects considered to be the strength of member units. Many studies have recently been published to help expand the field of medicine, biology, and pharmacy.
- 5. Invest in laboratory and research center infrastructure and facilities;** software and applications that support the management, storage, and sharing of research data to increase the presence of research results of scientists and research groups in cyberspace, on which the world's top universities such as Harvard (USA), Nanyang Technology University (Singapore), and others are implementing and expanding many specialized and multidisciplinary electronic databases.

## Discussions

The comprehensive analysis of Vietnam National University, Hanoi's (VNU) research outputs over the last 30 years has yielded several key insights:

- 1. Trend Analysis over 30 Years:** The data unequivocally illustrates a substantial progression in the research output of VNU. Periods of significant influence, such as increases in worldwide rankings, underscore the importance that external forces, such as policy shifts, and global events, have on the productivity of research. The results highlight the significant impact that strategic policy efforts have had, serving as catalysts for the progress made in research at VNU.
- 2. Shifts in Research Focus:** The data provides evidence of a calculated change in the emphasis of research, which is consistent with VNU's overarching goal of transforming into a research-centric institution. This transition has not only affected the research landscape at VNU, but has also made significant contributions to scientific disciplines, national progress, and strategic decision-making.
- 3. Collaboration and Research Trends:** The analysis uncovers divergent patterns in interactions between domestic and international entities, indicating the potential expansion of VNU's research network. The process of diversification has fostered a substantial interchange of concepts and approaches, thereby augmenting the caliber and extent of research conducted at VNU.
- 4. Interdisciplinary Research Trends:** An emerging pattern in multidisciplinary inquiry is suggestive of VNU's approach to addressing intricate global dilemmas. This methodology has facilitated the development of novel ideas and has been a factor in the university's increasing standing among scholars.
- 5. Citation Trends:** The rise in citations, specifically during specific time periods (e.g., during the COVID-19 pandemic), underscores the ability of VNU to tackle current world concerns. The significance and influence of VNU's scientific contributions are reflected in this trend.

## Conclusions

VNU's accomplishments in scientific research and international publications during the last three decades have been the result of a collective endeavor including its faculty, lecturers, researchers, and students. Consistent support for new researchers and formidable research groups, in addition to a steadfast commitment to scientific research funding, has propelled the university to notable progress across many academic and scientific domains.

With an eye toward the future, VNU is positioned to achieve even more remarkable triumphs in the realms of scientific research and instruction. VNU, by virtue of its steadfast dedication to educational reform, leadership in science, technology, and innovation, and well-established values, is exceptionally positioned to assume national obligations and contribute significantly to the scientific communities on a national and international scale.

## Suggestions for future work

- 1. Longitudinal Impact Study:** It is advisable to do additional research in order to evaluate the enduring consequences of VNU's research on technological and societal progress, in addition to its practical implications.
- 2. Policy Impact Research:** Thorough investigations examining the precise ramifications of VNU's policies on research outputs, supplemented by comparative assessments with other establishments, would yield invaluable knowledge.
- 3. Global Benchmarking:** An examination of VNU's standing in international rankings and its influence on global academic standards would provide a more comprehensive understanding of its ramifications.
- 4. Sustainable and Societal Impact:** Particular attention should be paid to the socioeconomic and environmental effects of VNU's research in the future, especially as it relates to tackling global issues.



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