

## UNIVERSITY RESEARCH CULTURE AS AN ESSENTIAL IMPACT FACTOR FOR HIGH-QUALITY ENGINEERING EDUCATION

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**Conference Key Areas:** *Future engineering skills and talent management, Niche & Novel engineering education topics.*

**Keywords:** *University research culture, faculty engagement in engineering research, faculty development.*

## ABSTRACT

Two missions of universities are generating new knowledge and disseminating it, hence the importance of research and publications activity. The current prevailing focus on research in academia - sometimes exaggerated to the detriment of teaching – is a debatable issue. Some benefits of promoting university research culture are undeniable; for example, faculty, by being involved into active research, can have better access to the state-of-the art knowledge in their field. In addition, active university research culture contributes to developing students' critical thinking and better equips students with the skills necessary to work in rapidly developing engineering areas. Thus, the developed university research culture offers an enriching environment for the students and positively contributes to the education process. In this paper we aim to evaluate the research culture of several Russian universities and to define a suitable metric for describing the level of their research culture development – the research culture index (RCI). For the universities with  $RCI > 1$  the research culture is well established and needs further nurturing. For the universities with  $RCI \leq 1$  the research culture is rudimental and needs to be established fully. We choose to focus on Scopus publications and age group of the faculty in order to compare various types of universities in Russia, including engineering schools and universities with engineering departments. Our findings clearly illustrate the challenging process the “old” universities had to go through to develop a research culture. The paper offers recommendations for all types of the universities under considering on how to improve their research culture.

## 1 INTRODUCTION

### 1.1 Background

Currently there are over 950 universities in Russia [1] and over 29,000 globally [2] and the competition among them is strong [3]. The Higher Education system in Russia has been transformed over the past 20 years, forcing organizations previously primarily focused on educational to become active in research [4]. In the last decades many Russian universities succeeded in drastically improving their publication records. However, the extent to which the internal research culture is affected remains little studied.

The Lotka's law sometimes is applied to assess the research production inequality [5,6,7]. The law states that “... the number (of authors) making  $n$  contributions is about  $1/n^2$  of those making one; and the proportion of all contributors, that make a single contribution, is about 60 %.” [8] Though it doesn't allow for the internal research culture analysis.

In this paper we investigate the state of the university research culture in several Russian universities. We imply that a vibrant research culture is essential for the quality modern education and talent attraction [9], in particular in rapidly evolving areas such as engineering. Further, we propose activities to improve the research culture including faculty development activities, students' engagement in research, and organizational changes to boost research synergy effects at the universities.

### **1.2 Research culture definition**

Before proceeding to the exploration of the research culture of the universities, we would like to clarify what we define as a "research culture". In this paper we adopt the following definition: "Research culture is a set of values, beliefs, assumptions and behaviors related to the implementation of research that owned by the organization collectively" [10].

Therefore, we investigate not just the cumulative research output of the university in terms of quality publications, but also identify the fraction of the full-time faculty members engaged in an active research, based on their publication output. We assume that once the fraction of such faculty members is large enough, the university naturally develops a set of collective behaviors supporting and promoting scientific curiosity: spontaneous research discussions during the coffee-breaks and lunches, official and unofficial research seminars, incorporation of the recent scientific discoveries in the educational lectures, etc. We also assume that the part-time faculty-members have little or no effect on the research culture of the university. This is due to a common practice in Russia where part-time faculty members are only nominal; they mention the affiliation of the University in their papers, while almost never being present in person, and thus unable to be actively engaged in or to affect collective behavior in anyway.

### **1.3 The purpose of the study**

The purpose of current research effort is to identify a metric for the assessment of the internal university research culture. For the universities where the research culture is immature we suggest the ways to improve it in a sustainable manner. The results of this study can be utilized by the universities in transition from a purely educational to an educational-research model.

## 2 METHODOLOGY

### 2.1 The Universities involved in the study

The data for the study were collected between November 2019 and March 2020 from 5 Russian universities. Table 1 summarizes the universities participated in this study.

*Table 1.* The Russian universities participated in the study

Label	Short description	Current position in QS BRICS <sub>2</sub>	Number of Scopus publications per faculty <sub>3</sub>
A	Polytechnic University at a metropolis in the North-West of Russia, 13,000 students, 419 faculty members	301-350	0,28
B	Polytechnic University at a metropolis in the East of Russia, 9,500 students, 650 faculty members	150-170	0,64
C	Federal University in the North of Russia, 10,500 students, 700 faculty members	201-210	0,34
D	Department of a major university in the capital, 29,000 students, 1,500 faculty members	30-40	0,86
E	Private university at a metropolis in the North-West of Russia, 110 students, 36 faculty members	-	0,46

### 2.2 Data collection

We have collected data on the full-time faculty members including their age group, and the number of the scientific publications indexed by Scopus in the last 3-5 years. We choose Scopus database as being the main metric affecting the university budgeting system in Russia. This metric is rather arguable and, unfortunately, leaves aside a lot of publications in engineering education research.

In addition, three of the universities mentioned in this research (Universities A, C, and D) had conducted a survey among the faculty members aiming to identify the challenges for the faculty preventing them from more active research, and asking about ways to support for helping faculty to improve their research record.

Over 32% of the faculty members anticipated in the survey at the university A, 49% at the university C, and 21% of the faculty of the department under consideration at the University D.

<sup>2</sup> <https://www.topuniversities.com/university-rankings/brics-rankings/2019>

<sup>3</sup> <http://indicators.miccedu.ru/monitoring/>

The questionnaire of the survey is presented at the Appendix 1.

### **3 RESULTS AND DISCUSSION**

#### **3.1 Resent publication activity by the faculty**

In this study we explored the research activity using the Scopus publication database. We tracked publications only by the faculty members with a primary affiliation at the university. We did so because it is common in Russia for faculty never to be physically present at their secondary affiliate institutions and not affect their research culture, while often contributing substantially to the overall publication metrics of those secondary institutions.

For example, a prominent scientist publishes actively with the university affiliation, but has a primary affiliation somewhere else. Such person will contribute a lot to the overall publication record of the university, but will not affect the research culture – will not communicate with the peers at the university, will not inspire the younger scientists, will not share their experience, and will not engage in joint research efforts.

Finally, here we have the significant limitation of not being able to track individual papers, but rather the number of the publications by every author, i.e. the joint paper by two researchers of the university is counted as two papers. This gives us a max estimation of the papers produced in the university.

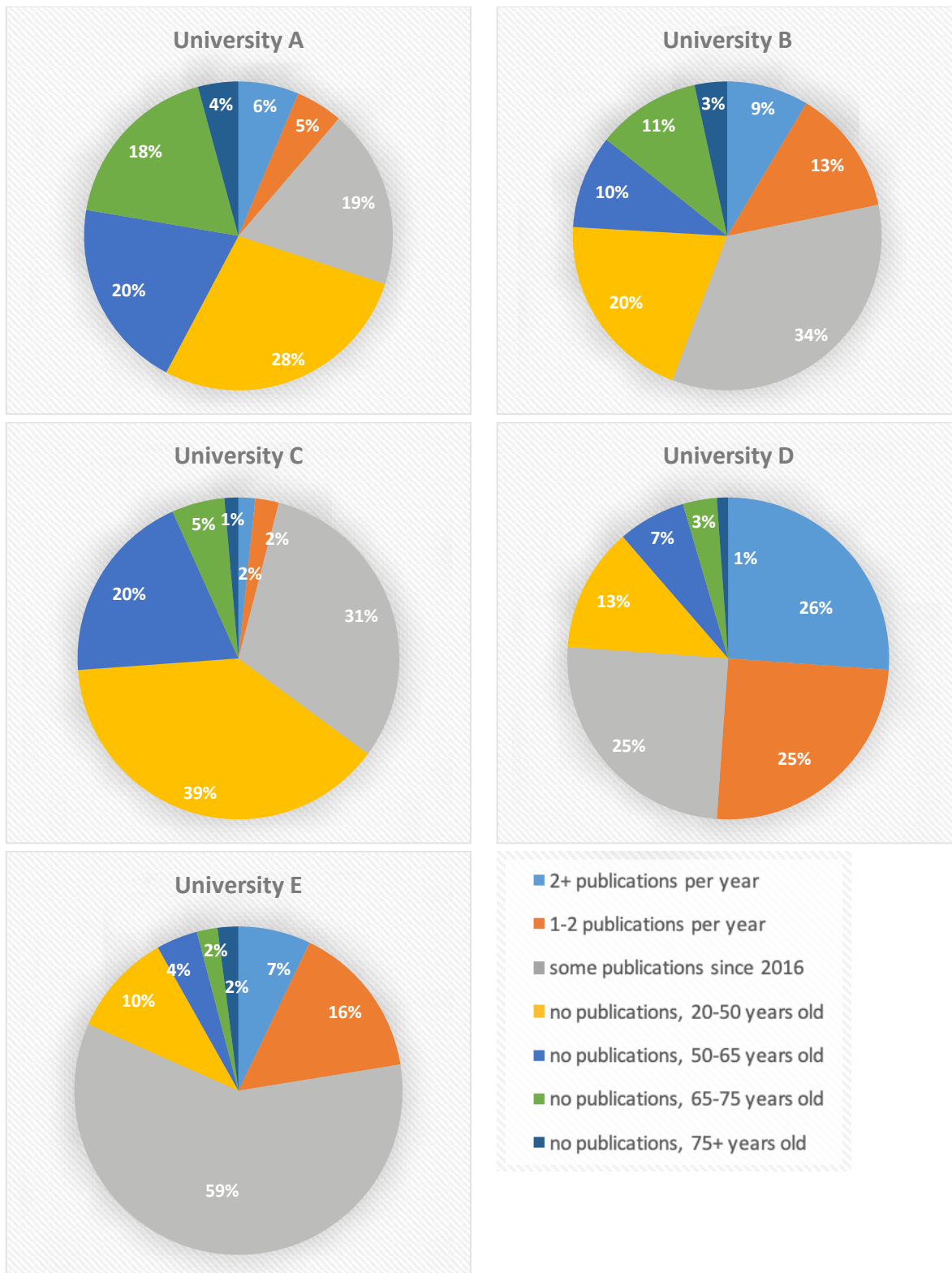
In order to simplify the comparison between the universities we define the following seven categories:

- Faculty members publishing at least 2 or more publications per year in 2018-2019
- Faculty members publishing 1 to 2 publications per year in 2018-2019
- The rest of the faculty with publications in 2016-2019
- Faculty with no publications in 2016-2019, and 20-50 years old
- Faculty with no publications in 2016-2019, and 50-65 years old
- Faculty with no publications in 2016-2019, and 65-75 years old
- Faculty with no publications in 2016-2019, and 75+ years old

Note that the retirement age set by the government in Russia since 2020 is 65 years old for males and 60 years old for females. However, the faculty are rarely stop working full time at the university after reaching the retirement age.

Table 2 summarizes the results of the comparison of the universities A, B, C, D, E on seven categories.

**Table 2. Recent publication activity comparison**



### 3.2 Defining the University research culture index

A metric one can propose by looking at the Table 2 charts: the ratio between the faculty who publishes regularly (2+ papers and 1+ papers per year) and the faculty without publications. The index highlights how visible the faculty performing an active research are among the peers at the university.

Table 3. The University research culture index (RCI)

University	A	B	C	D	E
RCI	0,16	0,5	0,06	2,13	1,28

The universities demonstrating an index value greater than 1 are the universities D and E. This means that the number of scholars of the departments actively engaged in the research is larger than those who do not publish due to some reasons. We can posit that the values, beliefs, assumptions and behaviours related to the implementation of research are solidly embedded in the culture of these universities. However, at the University E 59% of the faculty are “on pause”, not publishing for the last 2 years.

For other universities the faculty population is dominated by people with few or no research output at all. This is a warning sign. Even when the overall the number of publication per faculty member is rather high, like for the University B with Scopus papers per faculty of 0,64 (see Table 1), the internal university research culture index is low,  $0,5 < 1$ . The main contribution to research output is coming from the part-time faculty members.

Another example: The Universities C and E have similar publications per faculty ratios (0,34 and 0,46 respectively, 1,35 times difference). However, the research culture index is drastically different being 0,06 and 1,28 respectively (over 20 times difference).

The metric we propose is very rough and doesn't not allow for the detailed insight into the nature of the problem. However, it does indicate that there IS a problem, while the traditional indicators of the university overall may demonstrate a positive picture.

### 3.3 Analysing the faculty survey data

The Universities A, C and D have conducted surveys of their faculty members. The surveys were designed to identify the key factors preventing faculty members from producing Scopus publications and, for those publishing already, the factors preventing them from more active research.

Here we would like to mention that there are very few faculty members at each of the universities publishing more than two Scopus publications per year. For an average European scholar at the same time, we would expect to find 3 to 8 Scopus publications per year [11].

Please refer to appendixes 2, 3 and 4 for the detailed report on the faculty surveys at the universities A, C and D.

About half of the respondents at University A indicated the lack of time as a key reason for poor research productivity. The student to faculty ratio at the University A is over 30, which does indicate a problem with a teaching load for faculty. It is also inspiring to see that the faculty are more interested in professional support from University rather than increase in monetary stimulus.

For University C the financial aspects seem to be the most critical. Even though the average compensation for the faculty is 55% higher than the median for the region, it is still low compared to other universities included in this study. Many faculty members ask to reduce a teaching load, however at this university the students per faculty ratio is 14 and the teaching load should be normal. Therefore, the feeling of “no time” is probably related to time management issues and extra administration activities.

University D is the “healthiest” in terms of the research culture. The financial issues are less important for the faculty too. The average faculty compensation is over double the average in the region. However, there is a lack of understanding of why research is important and how it can contribute the faculty career.

### **3.4 Recommendations for improving the research culture**

Firstly, for the universities announcing research as one of their key missions, we recommend that every newly hired faculty member should demonstrate a track record of quality publications every year, at least one per year. Secondly, we encourage all universities/organizations to identify their uniqueness and to emphasis is (maybe it is sustainable development culture, rather than research). Finally, below we offer sets of recommendations for the universities with RCI above and below 1.

#### **3.4.1 Recommendations for the Universities with RCI=>1**

General recommendations for the universities having RCI => 1:

- a. Keep nurturing the research culture and emphasis the importance of research for the faculty members.
- b. Clarify the reasons preventing the inactive faculty from engaging in research
- c. Engage the inactive faculty in research by organizing activities, like open research seminars, yearly awards for the best first publication, improve international collaborations etc.
- d. For the faculty focused on teaching try to encourage them to explore possibilities of doing active research in the area of higher education.
- e. Engage students in research early. Support students' initiatives in exploring natural curiosity.
- f. Widen the multidisciplinary research collaborations with other national and international universities, for example Grand Engineering Challenges [12].



### **3.4.2 Recommendations for the Universities with RCI<1**

The universities with RCI <1 are lacking shared values, beliefs, assumptions and behaviors related to the implementation of research. The primary goal for such universities is to build an internal research culture and to embed that culture solidly in the university.

We recommend developing an action plan for the next 3-5 years focused on improving research culture. The activities would be focused on different faculty groups:

- 1) For those who publish at least one paper per year:
  - Review the teaching load for those who publish actively
  - Establish a university fund supporting travelling for the most important conferences to support publications
  - Introduce a regular seminar helping the authors to generate new ideas
  - Engage faculty in Engineering Education Research as an additional research area
  - Support national and international research collaborations
- 2) For those who publish occasionally or do not publish and are under 50 years old
  - Offer a training on academic writing
  - Offer a workshop on how to submit a first research paper
  - Organize activities assisting in finding co-authors within the university and beyond
  - Organize regular social activities helping to promote research culture
- 3) For those without publications and 50-65 years old
  - Offer access to the same trainings as above
  - Engage actively in the mentoring and supervision activities of the students and junior faculty in terms of teaching
  - Encourage to explore possibilities of doing active research in the area of higher education – offer thematic trainings.

In particular, for University A 42% of the faculty population is over 50 years old and without experience of publishing research results. This is an alarming signal and the revision of the faculty composition is crucial for the university to move towards the research and teaching paradigm.

## **4 SUMMARY AND CONCLUSIONS**

In this paper we have analysed Scopus publications by full-time faculty members at five Russian universities, including two technical universities and two universities with large engineering departments. Based on the data, we proposed a research culture index (RCI), as a ratio between actively-publishing and non-publishing faculty members at the university. Here we suggest that when RCI is close or greater than 1, the university enjoys a developed research culture. For the universities with RCI < 1 the organization has immature research culture, even when the total number of publications per faculty is high.

In addition, we have conducted faculty surveys at three of the universities in order to clarify the factors that prevents the faculty from publishing (or publishing more actively) and the assistance the university can offer to encourage publications. Based on the survey results and the RCI value, we proposed recommendations for the universities on how to improve their internal research culture. We assert, that a vivid inspirational environment, supporting natural curiosity of the students at the university is essential for quality education.

We encourage colleagues to apply the described methodology to analyse their universities/organizations. The proposed research culture index is easily applicable and could provide an interesting insight into the nature of the organization. The proposed method could be especially interesting for the universities in transition from an educational format to one of both research and teaching.

While providing consultancy services for the universities in Russia the authors faced a strong resistance in engaging faculty in research. The vast majority of the faculty are focused on teaching only and find it impossible to conduct research in engineer the same time parallel. Most of the faculty teaching engineering have never considered engineering education as a possible research focus. Among other action items we suggest to introduce faculty to research in engineering education, using the data from their primary activity.

Currently the implementation of the recommendations is in progress at University A. The results of the effort will be described in following publications.

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## Appendix 1

### The faculty survey

Please, underline your age group: (20-29), (30-39), (40-49), (50-59), (60-64), (65-75), (75+)

Please, underline your gender: Male, Female

1. Do you have an experience of publishing in English in venues indexed in Scopus?
2. Do you have at least 4 publications in Scopus in the last two years? If yes, please, indicate how many.
3. What is stopping you from starting to publish (publish more) in venues indexed in Scopus? Please choose no more than 3 items:
  - a) Not enough time;
  - b) I don't see value in such publications for my career;
  - c) Difficult to write in English;
  - d) Why even bother? Anyway, my article surely won't be accepted in such journals;
  - e) Not enough ideas for more publications;
  - f) No experience of submitting papers to Scopus journals;
  - g) The process is costly while the monetary stimulus from the university is small;
  - h) No funding to travel to a conference or for paper submission;
  - i) I conduct research on classified topics that can't be disclosed;
  - j) Your reply \_\_\_\_\_
4. What would help you to start publishing/publish more papers in Scopus venues? Please choose no more than 3 items:
  - a) Lower teaching load for those who publish a lot;
  - b) Provide assistance in establishing contacts with successful research groups;
  - c) Increase of the monetary stimulus for publications;
  - d) Help with new ideas generation;
  - e) Academic Writing Course in English offered by the university;
  - f) Guaranteed full/partial financing for trips to the best conferences where the papers were accepted;
  - g) Recommendations of Scopus venues where article are likely to be accepted;
  - h) Workshops on how to write a paper for a Scopus journal and submit it;
  - i) Workshops on how to publish research on classified topics;
  - j) Clarify how publications in Scopus will help my career in the university;
  - k) Your reply \_\_\_\_\_

## Appendix 2

### **The faculty survey results from University A**

At the university A over 38% of the faculty members participated in the survey. Approximately 2/3 of the respondents were from the category that does not publish and is under 50 years old, and about 1/3 from those who have the experience of Scopus publications already. Here we present the top 4 most popular answers.

Among the respondents without any experience of Scopus publications the most common preventing factors are:

- No experience of the paper submission in the international venue – 54%
- No time for research – 42%
- No financial support for attending conferences – 42%
- Difficult to write in English – 31%

The assistance they are looking for from the University:

- Professional training on how to submit the publication – 40%
- Academic writing course – 38%
- Recommendations for the journals/conferences to publish – 32%
- Assistance in establishing contacts with other research groups – 30%

Among those with Scopus publications already:

- No time for research – 55%
- No financial support for attending conferences – 42%
- Not enough monetary stimulus from the University for publications – 33%
- Lack of new ideas – 33%

The assistance they expect from the University:

- Increase of the monetary stimulus for publications – 42%
- Financial support for attending conferences – 41%
- Lower teaching load – 34%
- Help with new ideas generation – 28%

## Appendix 3

### **The faculty survey results from University C**

At University C 49% of faculty members participated in the survey. Here we present the top 4 most popular answers.

The respondents without any experience of Scopus publications the most common preventing factors:

- No financial support for attending conferences – 55%
- Not enough monetary stimulus from the University for publications – 55%
- No time for research – 42%
- Difficult to write in English – 35%

The assistance they are looking for from the University:

- Increase of the monetary stimulus for publications – 46%
- Financial support for attending conferences – 44%
- Lower teaching load – 39%
- Recommendations for the journals/conferences to publish – 33%

The respondents with Scopus publications experience:

- No time for research – 68%
- Not enough monetary stimulus from the University for publications – 58%
- No financial support for attending conferences – 49%
- Difficult to write in English – 21%

The assistance they expect from the University:

- Increase of the monetary stimulus for publications – 54%
- Lower teaching load – 50%
- Financial support for attending conferences – 44%
- Recommendations for the journals/conferences to publish – 33%

## Appendix 4

### **The faculty survey results from University D**

At the department of University D 21% of the faculty members participated in the survey. The total number of the responds is just 23 therefore the statistical reliability is low.

The respondents without any experience of Scopus publications the most common preventing factors:

- Difficult to write in English – 60%
- No experience of the paper submission in the international venue – 60%
- Don't see the value for my career – 40%

The assistance they are looking for from the University:

- Assistance in establishing contacts with other research groups – 50%
- Academic writing course – 50%

Among those with Scopus publications already:

- No time for research – 88%
- Don't see the value for my career – 29%
- Lack of new ideas – 23%

The assistance they expect from the University:

- Recommendations for the journals/conferences to publish – 35%
- Increase of the monetary stimulus for publications - 29%
- Assistance in establishing contacts with other research groups – 12%