# The Highly Cited Researchers with Researcher ID: Patterns of Behavior through Time

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## ABSTRACT

The aim of this paper is to follow highly cited researchers' patterns of behavior based on their publications and to study HCR active research life, how long do their cooperation relations last and whether we can distinguish differences between fields. Our sample included highly cited researchers who have Researcher ID from the Highly Cited Researchers list 2014, in total 329 names.

Keywords: Highly Cited Researchers, Researcher ID.

## INTRODUCTION

Since the beginning of century *Clarivate Analytics*[1] (till 2016 *Thomson Reuters*) has published six lists of researchers who have published the largest number of highly cited papers (rank in the top 1% by citations in *Web of Science*) in a particular field (in the 22 Essential Science Indicator fields).

The list has been adapted to the changing situation and the methodology and rules have been updated on an ongoing basis. The 2001 rules used membership thresholds derived from the total citation counts to an author's corpus in a specified research field and time window. The modified rules also include counts of individual highly cited publications, while the 2018 rules introduced the concept of cross–field influence.[2] On average, 5.6% of HCR names appear on more than one list (Table 1).

Already since the publishing of the first HCR lists, they have been under more focused investigation. The topic is diverse in terms of both content and geographical coverage. The majority of papers which has been published on the subject, can be divided into three broad groups:

1. Country and Institutional Level Analysis: Basu[3] proposed the new indicator, the Index of Citation Excellence (IoCE) which would be a more reliable indicator of research performance at the country level than 'citations per paper', as the latter yields unreasonably high ranks for small countries with very low productivity and is therefore unreliable as an indicator of country performance. Also she found that the probability that a country will have highly cited researchers increases in proportion to the square of its own research output. Followed by Bornmann, L, *et al.* studies on characteristics of highly cited researchers in Germany.[4,5] As well as Confraria *et al.*[6] Study about the characteristics of highly cited researchers in Africa and Li[7] study on the advancement of highly cited research in China, etc.

2. Research Performance of Highly Cited Researchers: Abramo[8] has suggested segmenting the approaches into at least three groups of contributions: a) bibliometric indicators proposed for the evaluation of performance in general and in consequence for the identification of top scientists; b) the study of the determinants of performance, particularly the personal and contextual variables that can make a researcher a top scientist; c) analysis of the role that top scientists have or should have within their institutional contexts. Parker, Allesina and Lortie[9] analysed the citation patterns and publication practices of the world's most highly cited environmental scientists and ecologists, inquiring into their levels of scientific productivity and visibility, examining relationships between scientific productivity and quality within their research programs and considering how different publication strategies contribute to these distinctive successes. They concluded that the highly cited researchers are also highly productive, publishing on average well over 100 articles each. Furthermore, articles published by this group are more highly cited on average than articles published in premier generalist journal like Nature and Science and their citation to publication ratios are more equitably distributed than is

typical. Research specialization and primacy of authorship are important determinants of citation frequency, while geographic differences and collaborative propensity matter less;

3. The importance of HCR lists is certainly enhanced by their use as an indicator in the Academic Ranking of World Universities.[2] Bornmann and Bauer[4] produced two ranking lists of the institutions on the basis of the number of highly cited researchers per institution: a) the list of institutions, based on the first-named institution for each researcher (his or her primary institution); b) the list of institutions, based on all the institutions named by a highly cited researcher. Also they highlighted a problem which some institutions have used to increase their position in ranking lists. This issue has been thoroughly discussed by Bhattacharjee,[10] and Gingras.[11]

Whereas highly cited researchers as a set individuals have been studied less. There are a number of barriers to conducting research at the micro level: Costas *et al.*[12] stated that bibliometric analyses at the micro level requires special caution due to the lower validity of statistical analysis applied to small units. Moreover, special diligence and precision is required for the collection and cleaning-up of data, the calculation of indicators and the final interpretation of results. Therefor obtaining precise and reliable measures of the research performance of individual scientists is a difficult and delicate task. Yamashita and Yoshinaga[13] analysed researchers CVs or Short Bios to investigate their researchers' life history. The aim was to demonstrate which conditions (citation impact, countries or sectors) are favorable for the analysis and to show structures of production of highly cited papers. Kawashima, H., Tomizawa[14] studied the concordance between Scopus Author ID and KAKEN (the biggest funding database in Japan) database as the source of "correct data".

The aim of this paper is to follow highly cited researchers' patterns of behavior based on their publications.

## Data and Methodology

The method for following high cited researchers' histories based on their publications was first suggested by Laudel[15] and elaborated by Yamashita and Yoshinaga.[13]

In addition to the data from the Highly Cited Researchers list 2014, we used sample data of highly cited researchers who have ResearcherID, in total 329 (10, 2%) names (Table 2).

The aim was to study HCR active research life, how long do their cooperation relations last and whether we can distinguish differences between fields. To ensure reliable data at the individual level we used sample data of highly cited researchers who have Researcher ID.

Firstly, we made basic searches by author identifier with the timespan of 1945–2014. In each case, we extracted the year of the author's first and last publication and the number of publications published during this period by the researcher. From this dataset created we tracked the durations of individual co-operations over the years.

## Findings
### Mobility

Several authors;[15-20] have pointed out the greater mobility of highly cited researchers. This is confirmed also by the sample data – 33, 3% of researchers work in at least two research centers at the same time. Among them, 59, 6% of researchers have their workplaces in two or even more different countries (Figure 1).

The Figure 1 highlights the higher mobility of researchers with Researcher ID, compared to the general list. We can assume that Research ID (in parallel with a number of other tools) will be taken by those researchers who are more active and focused on greater visibility. As our study is based on publications, this explanation remains at the level of the hypothesis until additional research methods are used.

Based on today's knowledge, we can refer to one factor that biased the 2014 list. This is the so-called King Abdulaziz University case, where due to active marketing the significant number of HCRs became part-time staff members of the university. This in turn contributed to university's rise to

**Table 1: The list of highly cited researchers (=HCR) by year.**

| Year | Total number of HCR | Number of HCR – unique values | HCR listed in several categories |
|------|------|------|------|
| 2001 | 7032 | 6473 | 559 |
| 2014 | 3215 | 3072 | 143 |
| 2015 | 3136 | 2951 | 175 |
| 2016 | 3266 | 3082 | 184 |
| 2017 | 3538 | 3362 | 190 |
| 2018 | 6079 | 5807 | 272 |

**Table 2: Highly cited researchers by Field.**

| Field | Total HCR | HCR with ResearcherID |
|------|------|------|
| Agricultural Sciences | 288 | 41 |
| Engineering and Technology | 187 | 30 |
| Medical Sciences | 751 | 28 |
| Natural Sciences | 1617 | 201 |
| Social Sciences | 372 | 29 |

the top of the HCR list, which implied a steadily improving position in rankings.[21-24] Currently, ARWU considers only the primary affiliations of Highly Cited Researchers,[25] which in turn has significantly reduced the proportion of secondary affiliations on the HCR list (in 2014 this proportion was 22, 1%, in 2018 – 14, 7%).

## Active research life period

Academic behavior and career dynamics depends on several determinants, it differ between countries, research fields, economic incentives, sociological factors (van Balen, *et al.* 2012). Emmer,[26] results in the solo author's dataset indicated that no clear relationship exists between juvenility or maturity of authors' careers and the impact of published solo author's articles, leading to the conjecture that the impact might rather be controlled by specific article related factors such as quality, novelty and the interest of the subject. The present sample also demonstrates the multiplicity of opportunities. Where on the list is a Plant and Animal Sciences researcher with 52 years of publication experience and a social scientist with one year of publication experience. At the same time current results show that the length of a scientific career has an impact on success. As we see from Figure 2, the productive output period can last a lifetime. At the same time in the majority of cases highly cited researchers belong to the group who has been in the field for 11 to 15 years, the second largest group are those who have worked in the area for more than 31 years (on an average 19.5%). In Medical Sciences, 50% of highly cited researchers belong to the group who have published for 11 to 15 years. On an average, the longest period of productive years is in Agricultural Sciences (22.6), followed by Engineering and Technology (20.1), Natural Sciences (19.2), Social Sciences (18.1) and Medical Sciences (17.3).

## Publication trends

Following the publication trends of highly cited researchers over the years, we can see changes in the research areas. The main trends remain the same but interdisciplinary research is rather the rule than the exception. Four percent of highly cited researchers from the total list are noted as highly cited in various areas.

The most frequent combinations were Chemistry and Material Sciences, Biology and Biochemistry and Molecular Biology and Genetics, Clinical Medicine and Molecular Biology and Genetics, Computer Science and Engineering, Computer Science and Mathematics, Engineering and Mathematics. But there are also such combinations as Clinical Medicine and Social Sciences, Biology and Biochemistry and Economics and Business, Molecular Biology and Genetics and Computer Science and Biology and Biochemistry.

As selection was made to only those authors with a required number of highly cited papers in a single field, then it discriminated researchers who published highly cited papers in several fields but not enough in any one field to be chosen. Since 2018, *Clarivate Analytics*[1] uses a new Cross-Field category to identify researchers with substantial influence across several fields during the last decade. Some 2,000 authors with cross–field impact were added into list (Highly Cited Researchers).

The average number of articles depends on the field (Figure 3). The average number of papers is the lowest in Social Sciences (140) and Agricultural Sciences (150). The highest number of papers is in Medical Sciences (332) and Natural Sciences (252). The latter is largely dependent on the number of co-authors. The same trend was also stressed by Parker, *et al.* 2019,[9] who investigated highly cited researchers in the environmental science and ecology and pointed out that highly cited researchers are also highly productive, publishing on an average well over 100 articles each.
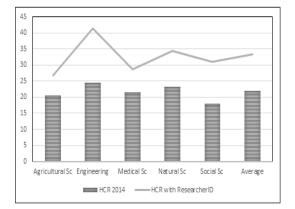


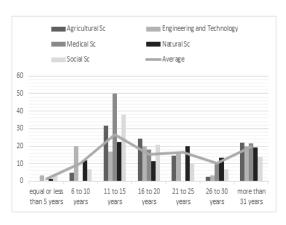**Figure 1:** The proportion of HCR with more than one affiliations (%).



**Figure 2:** Distribution of highly cited researchers by productive output period and by research area (%).
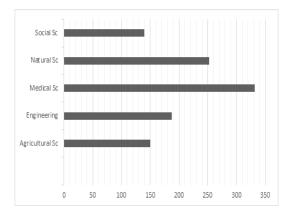
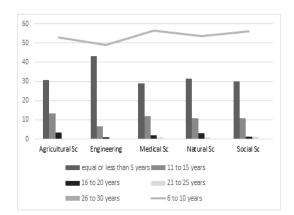**Figure 3:** The average number of paper by field.



**Figure 4:** The length of cooperation by the areas (%).

## Collaboration

Collaboration has an important effect on researchers' productivity.[27-31] We have to take into account different factors, such as discipline, collaboration patterns, nationality, geopolitical location, cultural relations and language, also different career stages. However, partnership is a long-term process for researchers, in some cases lasting throughout their whole active life period.

In the rapidly changing and increasingly globalized world we begin to forget the importance of personal contacts, namely the importance of personal chemistry. Despite the view that highly cited researchers are flexible in establishing new contacts, Figure 4 shows that in maintaining partnerships, behavior is quite pragmatic. In most cases collaboration lasts for 6 to 10 years. It is noteworthy that every tenth researcher's cooperation relations have lasted for more than 11 years.

## DISCUSSION AND CONCLUSION

When interpreting the data, we must consider that the object of the study consists in highly cited researchers who have an obvious interest to expand cooperation in the area (creation of a Researcher ID account is optional). Moving forward in this direction would make sense to use HCRs social web, open access, out links data as well. Data from current study show that HCRs have greater mobility, in the majority of cases they belong to the group who has been in the field for 11 to 15 years, they are highly productive, publishing on average over 100 articles each and interdisciplinary research plays a definite role in their careers. At the same time, they are loyal to their collaboration partners. Despite the view that highly cited researchers are flexible in establishing new contacts, current study results show that in maintaining partnerships, behavior is quite pragmatic. In most cases collaboration lasts for 6 to 10 years. It is noteworthy that every tenth researcher's cooperation relations have lasted for more than 11 years.

## CONFLICT OF INTEREST

The author declare no conflict of interest.

## ABBREVIATIONS

**HCR:** Highly Cited Researchers; **IoCE:** Index of Citation Excellence; **ARWU:** Academic Ranking of World Universities.

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