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Frequency of Scientific Production in

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Summary

The aim of this research is to investigate the development of the Information Sciences in Croatia. The specific research goal was to follow scientific production of the doctoral candidates after completion of their doctoral studies according to discipline of research (primarily in the area of Information Sciences) and frequency of scientific production. 2,402 relevant scientific papers written by 107 doctoral candidates were found or 22.45 scientific papers per author. The majority of papers were written in the field of the Information Sciences and after the doctoral graduation. The results of this research may be considered to be a solid indicator of the scientific production in the area of Information Sciences.

Key words: Information Sciences, scientific production, doctoral candidates, CROSBI

Introduction

Considering the fact that scientific production is one of the major indicators for development of a scientific discipline, the starting point of this research was the list of all candidates for Ph.D. in Information Sciences from 1978 to 2007 at

Croatian universities[1]. Their scientific production had been analyzed according to Croatian Scientific Bibliography database. This is a database sponsored by the Ministry of Science, Education and Sports of the Republic of Croatia, which contains the list and description of those scientific papers published within projects financed by the Ministry of Science, Education and Sports of the Republic of Croatia.

Croatian Scientific Bibliography (CROSBI) database is an electronic database that allows for data input and search through a web interface, offers fast access to scientific publications from a particular science project or scientist and enables the user to find scientists working in narrow, highly specialized scientific fields in Croatia. CROSBI was initiated in 1997 with the fundamental goal of collecting in one place all publications resulting from scientific projects financed by the Ministry of Science, Education and Sport of the Republic of Croatia. Authors themselves create the bibliography, while librarians, computer and information specialists supply the forms, standards and monitoring of the entire process.

CROSBI is a database open to all types of science papers, journal articles, books, book chapters, proceedings of scientific symposia as well as all types of papers, expositions, technical reports, manuscripts et al. CROSBI currently stores data on 190,000 scientific and professional papers along with 4,000 complete works by Croatian authors.

The specific research goal was to follow scientific production of Ph.D. candidates after doctoral graduation according to discipline of research (primarily in the area of Information Sciences) and frequency of scientific production.The analysis covered 2,402 relevant scientific papers written by 107 Ph.D. candidates or 22.45 scientific papers per author. The data from the papers that had been analyzed was introduced into Microsoft Excel worksheets, where most important data included: publication year, scientific field and paper category (scientific papers, professional papers…)

Data analysis

Having collected the data, it was necessary to perform basic data analysis so the collected data could be used and studied. The first step was establishing a relationship between the dates papers had been published and their authors' graduation. This was done in Microsoft Access format, which produced new data – a numerical indicator of the age of published literature. For example, papers written 10 years after completing the doctoral study were marked as 10, while those written 4 years prior to completion of doctoral study were marked as -4.

The next step of the analysis focused on scientific areas covered in the papers. All the works from the domain of Information Sciences (including those which

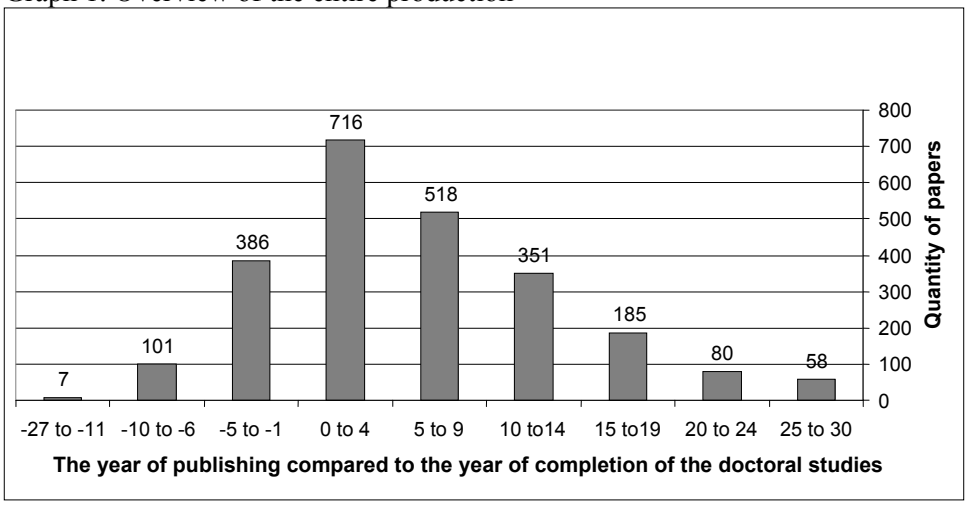
[1] All data on Ph.D. graduates in Information Science taken from Đ. Pečarić (2009).

covered other areas such as for example: Information Sciences and Economics) were labeled as Information Sciences while papers addressing different areas were labeled as Other. A number of papers dealt with non-scientifically definable areas and were therefore labeled as Unknown/Unclassified.

Presentation of the frequency of the scientific production

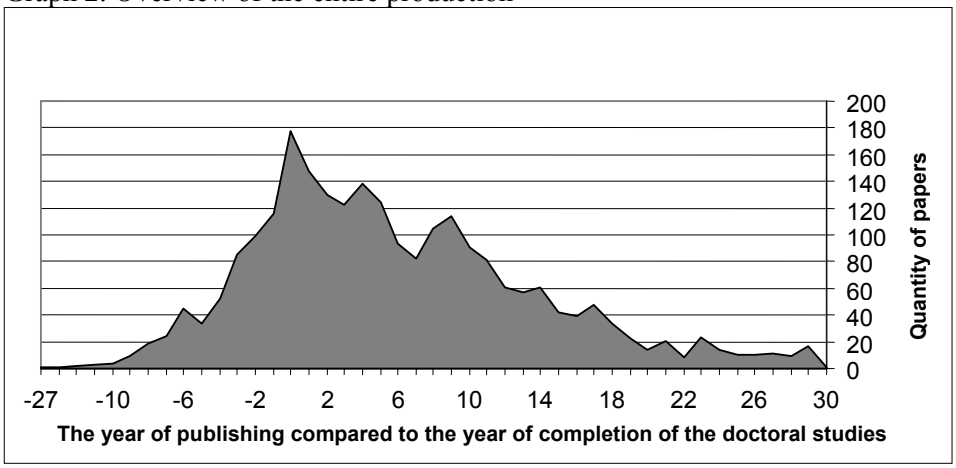
Having analyzed the data, it was possible to use graphs to present the findings. Graphs 1 and 2 show the entire scientific production in relation to completion of doctoral studies.

Graph 1. Overview of the entire production



The graphs indicate that the "first" paper was written 27 years prior to completing the doctoral study, the "last" one dating 30 years after the completion of the doctoral study. This should not come as a surprise bearing in mind the age of the oldest doctoral candidates 75 and 71 as it is fair to assume that the majority of their work had been done prior to the completion of their doctoral study. On the other hand, the youngest doctoral student completed the study at the age of 28 which suggests that their works are yet to be submitted during the course of the forthcoming career. The ideal option for producing a graph that illustrates the scientific production before and after completion of doctoral studies would be based on data from a reference database to contain a number of doctoral students of the same age and who have completed their studies in the same year. Apart from the above mentioned information, the graphs clearly suggest that the majority of the scientific production was submitted during the year of completing doctoral studies, marked as 0, as many as 178. Another strong indication is of the increase in production closer to the time of completion of studies and the decrease coinciding with the lapse of time.

Graph 2. Overview of the entire production

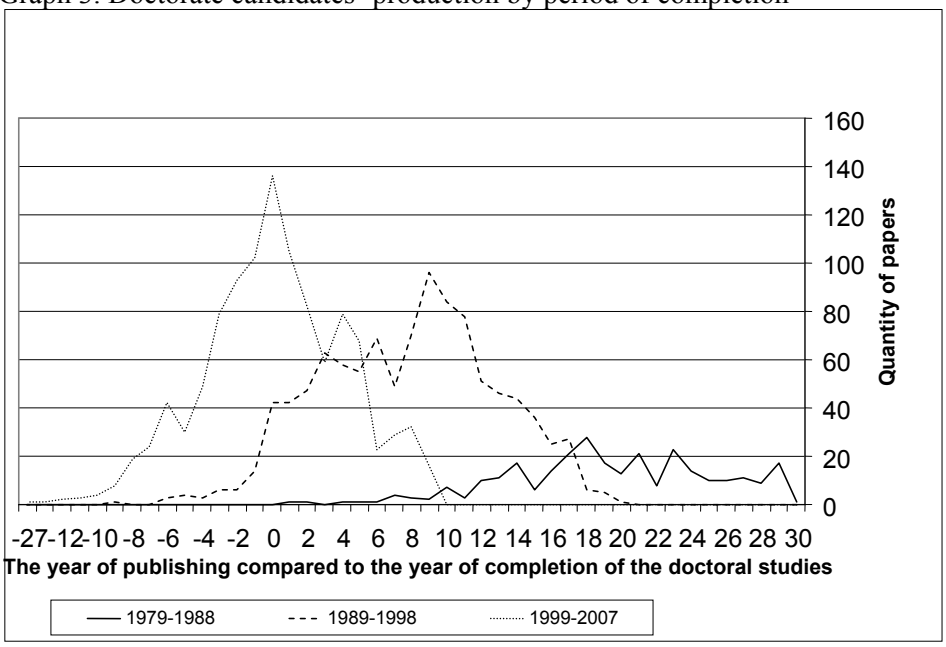


This finding can be explained partly by the limited database. As previously mentioned, the doctoral students completed their studies during the period 1978-2007 (this period is 1979-2007, if only published work is taken into consideration). The papers contained in the database were published between 1980 and 2009. In order to achieve more precise indicators of the scientific production, the database should include all the works produced within the period of 30 years from the time of the completion of studies of the oldest doctoral student and 30 years after the youngest candidate completed the studies.

Since these conditions were impossible to establish the doctorate graduates have been divided into three groups based on the year they completed their doctoral studies (Graph 3), into ten-and nine-year periods. The goal of this division was to demonstrate there was no actual drop in scientific production after the completion of doctorate studies. This graph shows that the reason for the seeming drop in production shown in Graphs 1 and 2 lies in the relatively small sample of published papers. Graph 3 demonstrates an increase in production after the completion of doctorate studies in doctors from the period of 1979 to 1988 (solid line), an increase in production after the completion of doctorate studies in doctors from the period of 1989 to 1998 (dashed line), as well as increased production before completion of doctorate studies in doctorate candidates from the period of 1999 to 2007 (dotted line).

Graph 3 demonstrates that Information Sciences are marked by steady development and that scientific production grows after the completion of doctorate studies. Even better results would have been obtained with a demonstration of production for each individual year; however that was not possible with this research paper for practical reasons.

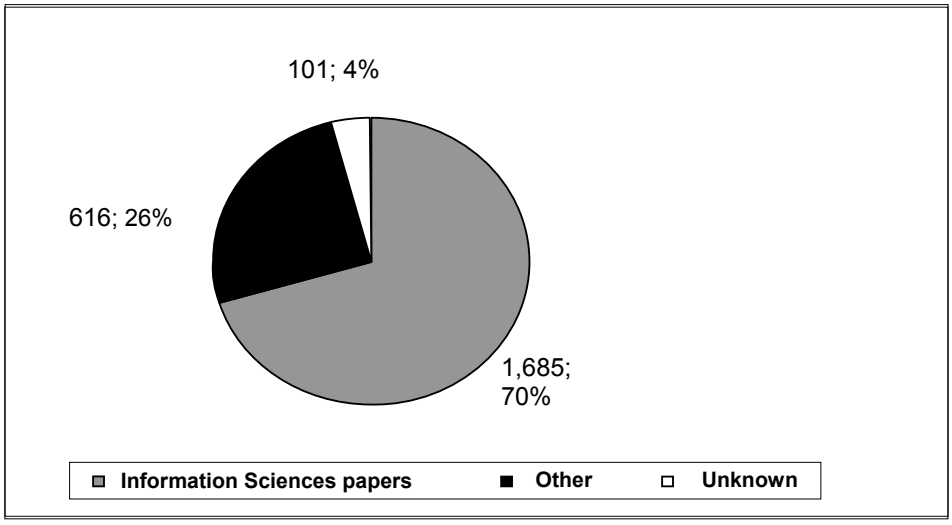
Graph 3. Doctorate candidates' production by period of completion



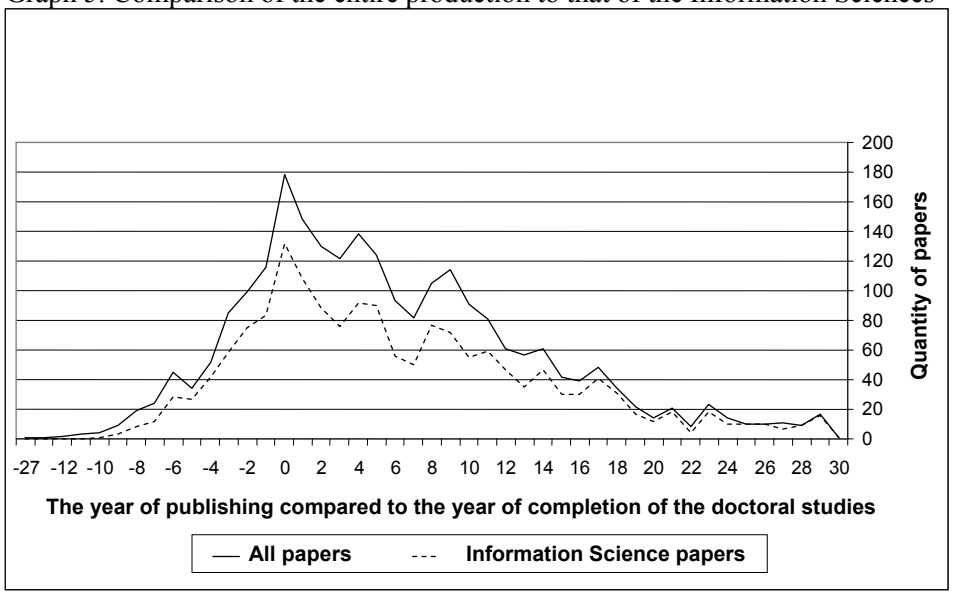
Graphs 4 and 5 illustrate the production of scientific papers in relation to the respective scientific areas. As expected, the Information Sciences doctoral students produced the majority of their works within the specific domain of their research. In total, 1,685 papers were submitted in the area of Information Sciences and they account for 70% of all the works. Graph 5 tells us that ratio between production in information sciences and other science is constant. In other words, scientists and explorers of information sciences are always present, with almost one third of their scientific productivity in at least one scientific area.

Graph 5 compares the entire production to that of the Information Sciences. It suggests the absence of any deviation within periods of publication of the works. Consequently, the most productive year was the year zero (the year of completion of the doctoral study) in which as many as 132 works were written. Those years that saw fewer works being published equally reflected lower difference in production. It is important to draw attention to the fact that the „oldest" work from the field of Information Sciences was published 10 years prior to its author completing the doctoral studies.

Graph 4. Production of scientific papers in relation to the respective scientific areas



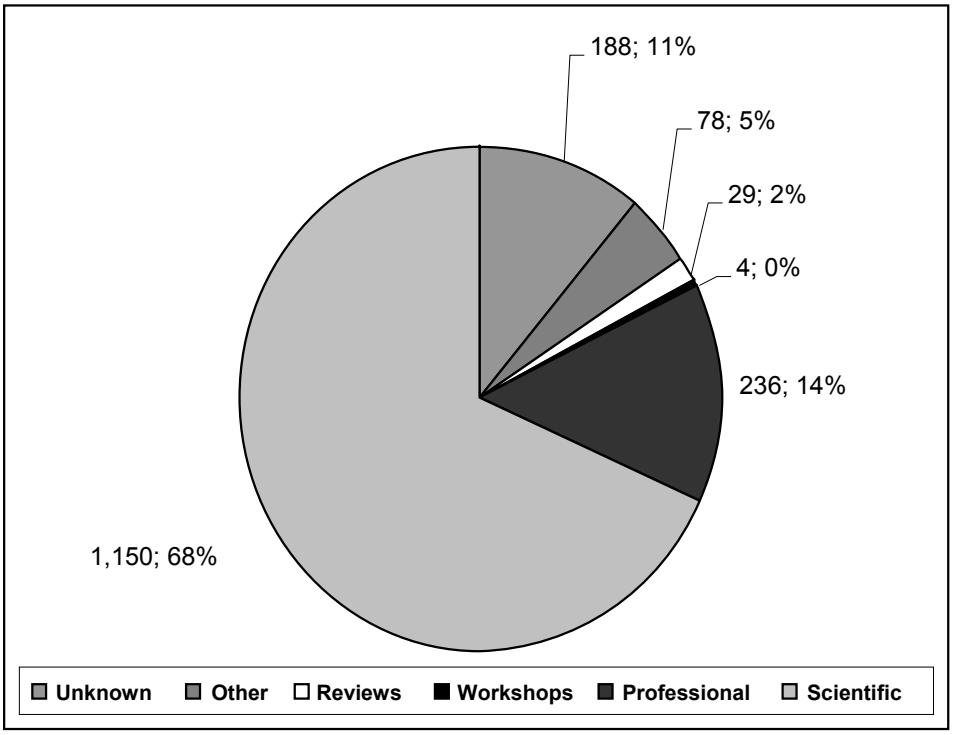
Graph 5. Comparison of the entire production to that of the Information Sciences



The following graphs clearly illustrate the relation of the works contrasted against the categories of the Information Sciences. Graph 6 shows the overview of the distribution of all categories where scientific papers are represented with 68% or 1,150 papers, well above the others. The second most represented works

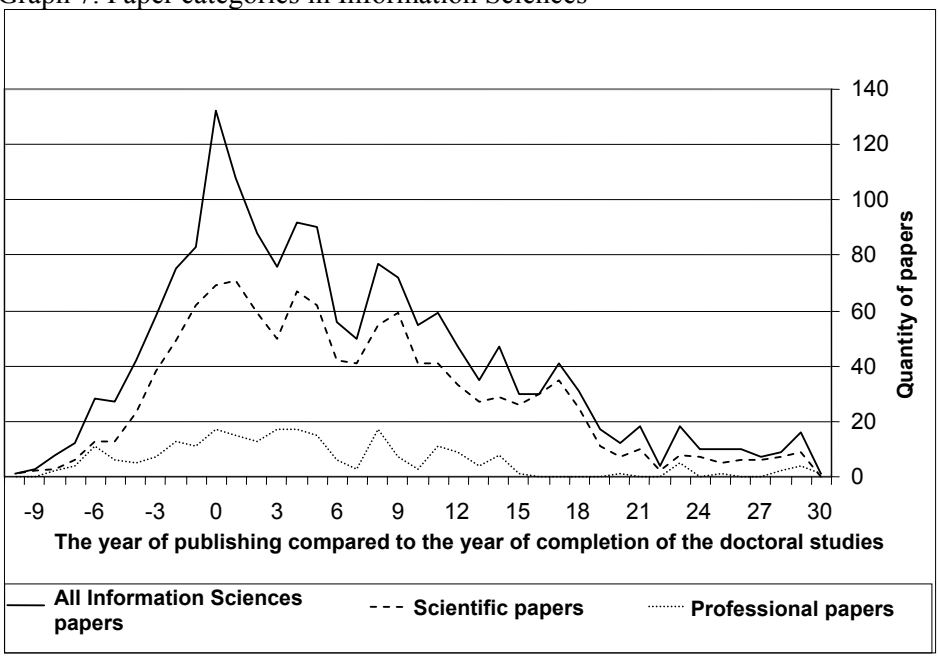
are expert papers with 14% or 236 papers. There were only 29 reviews or 2%, whereas there were an insufficient number of workshops to merit the comparison, only 4 papers. It is interesting to observe that as many as 11% of all papers have no qualification of category, which is a sizeable omission for a database.

Graph 6. Paper categories in Information Sciences



Graph 7 represents the comparison of the Information Sciences works with scientific and professional works that were available in sufficient numbers. It clearly documents that the works follow the trend of the whole production with the Information Sciences and reiterates that the scientific works account for the majority of the scientific production as well as the year zero being the most productive.

Graph 7. Paper categories in Information Sciences



Discussion

Based on the data analysis of the scientific production of doctoral students in Information Sciences in the period between 1978 and 2007 several conclusions have been made despite the misgiving that the data for the initial ten-year period was incomplete as a result of the Croatian Scientific Bibliography having been established as late as 1997.

The database registers the scientific production of 107 (79.8%) of 134 doctors of Information Sciences. It is necessary to point out that these are doctors of Information Sciences who have graduated in Croatia and not all doctors of Information Sciences active in Croatia. The question is where are the “missing” 20% of the doctors of Information Sciences. Are they lost to scientific work? In other words have they relinquished scientific activity altogether or only their activity in Croatia?

Another important realization is that scientific production is relatively large (22 scientific papers per doctor). The data for individual years shows that every doctoral candidate on average published 1.66 papers in the year they completed their doctoral studies, 1.38 in the first year thereafter, 1.21 in the second year, 1.14 in the third, 1.29 in the fourth and 1.16 scientific papers in the fifth year after having completed doctoral studies.

There is an evident difference in scientific production before the completion of doctoral studies between particular scientific groups. Those who completed their doctoral studies in the first ten-year period (1978-1988) show a longer sci-

entific productivity before attaining their doctorate. The reason for this is found in the fact that Information Sciences have been present in Croatia since the 1960ies, but it was not possible to achieve a doctorate in that discipline until a lot later. It logically follows that scientific production before the completion of doctorate studies would be greater for that particular group in that period than it is for the group in the latest period observed. Doctors from the latest period enter the field of Information Sciences as junior researchers, normally immediately upon completing their studies.

The third significant factor of the scientific production is a relatively large number of original scientific papers (68%) and a relatively small number of professional papers (only 14%) and merely 2% of reviews.

This data leads to the question of character and goals of scientific research activity in Croatia. The small number of professional papers points to the fact that scientists are rarely involved in applied science and developmental research. This leads to conclude that Information Sciences in Croatia are not focused on applied and developmental research, but on fundamental research. The question is whether this kind of research is at all useful. Another way to look at the data is to wonder whether the number of original scientific papers, which takes up two thirds of all scientific production, is, perhaps, overrated. In other words, perhaps the classification of original papers is not realistic.

Conclusion

The production of scientific works is one of the most significant indicators of the development of any scientific area. The same applies to the Information Sciences. The aim of this paper was to establish whether Information Sciences follow the positive trend and if it is possible to present and predict the frequency of the scientific production. The given results indicate that the aim has been achieved. Although the works used for this research were published over a relatively short period (as mentioned before), the collected data suggest the advent of the Information Sciences. The same data can be used for the future research which would be most valuable and welcome as it could echo the reality and contrast it against the optimistic forecast.

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