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**DIRECTORATE FOR SCIENCE, TECHNOLOGY AND INDUSTRY  
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**Working Party of National Experts on Science and Technology Indicators**

**EMPLOYMENT CHARACTERISTICS OF PhD HOLDERS IN THE FIELD OF SCIENCE AND  
TECHNOLOGY – INDIAN EXPERIENCE**

**WORKSHOP ON USER NEEDS FOR INDICATORS ON CAREERS OF DOCTORATE HOLDERS  
OECD, Paris-La Défense, 27 September 2004**

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## **EMPLOYMENT CHARACTERISTICS OF PhD HOLDERS IN THE FIELD OF SCIENCE AND TECHNOLOGY – INDIAN EXPERIENCE**

### **Introduction**

1. It needs hardly any mention that science and technology play a crucial role in the overall development of any country. Government of India has been supporting science and technology right from 1947 after independence. This support is being provided through setting up of educational institutions, national laboratories, and also by way of providing fiscal incentives for research and development. At the time of independence, there were only 20 universities and 500 colleges in the country. Currently, there are about 221 universities and over 10,000 colleges i.e. there is nearly 11 fold increase in the universities and 21 fold increase in the number of colleges. In addition, there are a number of national laboratories and in-house R & D laboratories in the industrial sector for promotion of research and development in the country. The National Policy on Education, 1986 and the New Science and Technology Policy, 2003 also focus on research and development and education in science and technology and lay special emphasis to establish networks between different institutions in the country to pool resources. As a result of sustained interest of the Government, the out-turn of doctorate degree holders in science and technology has been growing year by year ever since 1951 when only 180 PhDs were produced. This number grew to 713 in 1960; 2280 in 1970; 2973 in 1980; 4579 in 1990; 5725 in 2000 and this number has grown to 5822 in 2001. The subjects which are recognized by the Indian Science Congress as the subjects to be covered under Science and Technology are listed in Annex I

### **Career profile of PhDs – outcome of studies**

2. The Department of Science and Technology, Government of India has sponsored a number of studies the career profile and pattern of utilization of PhDs in science and technology with the objective to bring out certain features such as distribution of PhDs by age groups, sex, nature of duties, matching of specialization, type of organizations employing them, career progression and migration to overseas. Studies are based on sample surveys through mail cards. Studies have also been sponsored to identify the factors responsible for migration of S&T personnel of premier institutions. In one of the nation-wide surveys, a questionnaire was addressed to 19,366 PhD scholars. 3200 questionnaires were received and analysed. These PhD scholars included 2803 males and 397 females in the ratio of 87.6% and 12.4%.

### **Age structure**

3. The research scholars by design were classified into four groups namely upto 30 years, 30-39 years, 40-49 years, 50 years and above. The survey reveals that the maximum number of PhD holders (45.9%) fall in the category of 30-39 years; followed by the age group of up to 30 years in which 33.2% of PhD holders fall. 19% fall in the age group of 40-49 years and 1.9% in the category of 50 years and above. This feature that maximum number of the PhD's fall in the age bracket of 30-39 is true for males but not for the females. The majority of females (51%) completed their PhDs by the age of 30 years.

4. The break-up giving genderwise details is given below :

**Distribution of scholars by age groups and sex at the time of attaining PhD**

Age group	Males	Females	Total
Up to 30 years	858 (30.6%)	204 (51.4%)	1 062 (33.2%)
30-39 years	1 317 (47.0%)	153 (38.5%)	1 470 (45.9%)
40-49 years	569 (20.3%)	38 (9.6%)	607 (19.0%)
50 years and above	59 (2.1%)	2(0.5%)	61 (1.9%)
<b>TOTAL</b>	<b>2 803 (100.0 %)</b>	<b>397(100.0%)</b>	<b>3 200(100.0%)</b>

**Employment status**

5. Out of 3,200 scholars who were holding PhDs degrees, 3058 reported as employed. Out of the remaining 142, 132 reported as unemployed and 10 reported that they did not seek any employment. The Survey revealed that overall employment among males was higher (97.5%) than among the females (82.1%). It also revealed that employment pattern in all age groups excepting the age-group of 50 years and above is higher for male PhD's than the female PhDs. The employment pattern in the various groups both for males and females is reflected in the following Table :

Age Group	Employed male PhDs	Employed female PhDs No.
Upto 30 years	100	25
30-39 years	1459	230
40-49 years	956	60
Above 50 years	217	11
<b>TOTAL</b>	<b>2732</b>	<b>326</b>

**Waiting period for employment**

6. There could be two modes for undertaking research work leading to PhD Degree. In one, the person could be employed and takes up research work for attaining PhD. In this case, the waiting period for job would be almost zero. In another mode, the person is unemployed and seeks job after getting PhD. Waiting period would be applicable in this case only. The shorter waiting period would be indicative of higher demand of the PhD while longer waiting period would indicate otherwise. In the Indian context, the waiting period varied from one month to four years. 86 per cent of the PhDs got employed within a month. The waiting period did not show any significant variation for males and females

**Activity profile**

7. The research and development activities in any country are the source of creating new knowledge. For this purpose in the survey it was ascertained whether those holding PhD degrees are engaged in R&D or otherwise including teaching, management administration, quality control or doing dual functions like research and teaching as is applicable in any academic institution. The survey revealed that majority of the PhDs, (38%) are engaged in teaching, 29.4% are engaged in research, 24.3% are engaged both in teaching and research and 8.3% are engaged in other activities such as management administration, quality control etc. This features that PhDs are digressing towards administration, quality control, management is indicative of internal brain drain. The activity profiles of the males and females

reveal that both are engaged more in teaching profession as compared to research. The activity profile is given below.

<b>Activity profile (%)</b>		
	<b>Male</b>	<b>Female</b>
<b>Research</b>	<b>29</b>	<b>32</b>
<b>Teaching</b>	<b>36</b>	<b>51</b>
<b>Teaching and research</b>	<b>26</b>	<b>10.5</b>
<b>Others</b>	<b>8.5</b>	<b>6.2</b>

8. In this context, it may be mentioned that subjects like technology, agriculture and geo sciences are more popular in males as compared to females. On the other hand, bio-sciences, medical sciences, home sciences and anthropology are more popular in females. Physical sciences are equally popular both in males and females.

### **Salary profile**

9. In India, the salary structure has been classified into four grades, viz., Grade-A, Grade-B, Grade-C and Grade-D. Grade-A Officers are higher in status than Grade-B and similarly, this is applicable to Grade-B and Grade-C, and Grade-D Officers. Even in Grade-A Officers, there are further categories which have been represented here as A, A1, A2. The distribution of PhD holders in various Grades is given in the following Table :

**Salary profile of PhDs**

Pay grade	Teaching	Research	Other than research & teaching	Total
Below grade A	76 (4.3%)	133 (13.2%)	45 (19.2%)	254 (8.4%)
Grade A	974 (55.1%)	365 (36.3%)	72 (30.6%)	1411 (46.0%)
Grade A1	575 (32.5%)	498 (49.5%)	118 (50.2%)	1191 (39.6%)
Grade A2	143 (8.1%)	10 (1.0%)	-	153 (5.1%)
<b>Total</b>	<b>1768 (100%)</b>	<b>1006 (100%)</b>	<b>235 (100%)</b>	<b>3009 (100%)</b>

Grade A1 is higher than Grade A.

Grade A2 is higher than Grade A1.

10. The survey revealed that out of 3009 scholars who furnished information about their salary status 254 scholars ( 8.5%) are getting salaries below grade A Officers, and thus are considered as under placed in spite of holding doctorate degree in the field of science and technology. During the survey it was also attempted to investigate how the careers of PhD holders have progressed. 2973 candidates furnished details about their career progression out of 3009. The analysis revealed that as many as 66 candidates constituting 4.1% of 2973 are holding less than Grade A post, even after a period of 10 years. Such a number in case of teaching organization is 28 while in research organization the number is 26 and 12 candidates belong to the area other than research and training. Although the number of such PhDs holding less than Grade A position and engaged in teaching and research is not much different (teaching – 28, research – 26), even then one may decisively conclude that the career progression in teaching organization is slower than the career progression in research organization. PhD holders are better off in areas other than research and

teaching at lower level. However, their career progression is restricted to middle level only. No PhD holder has reported position in A2 category in the areas other than research and teaching.

### **The type of employer**

11. Broadly, the employers have been classified as government (Federal and State), universities and autonomous institutions, industry (public and private) and self employed. Out of 3200 scholars, 3058 have reported as employed. Out of this 3058, only 3009 gave information regarding the kind of employment. The Survey revealed that maximum number of PhDs are employed in University and Academic and autonomous Institutions (70.8%). The Government is the second largest employer of the PhDs (22.5%), 6.5% were employed in industrial sector (4.1% with private, and 2.4% with public) and only 0.2% fell in the category of self-employed.

### **Objective of acquiring PhD and degree of realization of such objectives**

12. The objective of undertaking PhD by various candidates would apparently vary from candidate to candidate. These objectives might include sponsorship by the organization, pressure from employer to fulfill the mandatory requirement to improve career prospects, genuine desire for creating new knowledge etc. Out of 3200 responses, 2853 respondents gave specific answer to queries made. The survey revealed that 73.1 % respondents attained the PhD degree with a genuine desire for creating new knowledge, 65.4% undertook PhD degrees to improve their career prospects, it was only 14.9 % who pursued PhD to get a particular job and 7.5% were sponsored by the organizations. It was further analysed whether there were any variations in the objectives of males and females. It was observed that the genuine desire for creating knowledge was more in females (82.9%) than in males (71.7%) This feature was true for improving the career prospects as well. For this purpose, the percentage in female and male remained as 68.3% and 65% respectively.

### **Realisation of objectives**

13. The survey revealed that majority of the PhD holders (63.2%) accepted that PhD Degree was instrumental in attaining the objectives. 25.1% stated partial fulfilment while 11.7% reported that they could not achieve the objective at all. Percentage of respondents age wise and gender wise who attained the objectives is indicated in the Table Below :

Age group	Males	Females
Below 30 years	65.6%	34.6%
30-39 years	66.2%	59.8%
40-49 years	60.7%	64.9%
50 and above	61.7%	45.5%
All ages	63.9%	58.2%

14. It is evident from here that higher percentage of males could attain the objectives as compared to females in every group except the age group of 40-49 years. This difference is strikingly higher in the age group of below 30 years.

### **Linkages of qualification with employment**

15. Majority of the respondents (41.4%) reflected that the positions they were holding required PhD degrees as the desirable qualification, 29.3% mentioned that PhD was an essential qualification for the position they held and for the remaining 29.3% respondents PhD was neither essential nor desirable. While analyzing the responses of males and females for the positions, it was observed that 29.5% of the males were holding such positions where it was not essential or desirable and this percentage for the female was 27.8%. The feature of holding positions which do not require PhD degree is indicative of their career profile.

### **Matching of specialization with job**

16. 57.6% of the respondents mentioned that there was a proper matching between the field of specialization and the area of work assigned to them, 28.6% respondents reflected partial match and the remaining 13.8% indicated that there was no match between the field of specialization and the area of activity. This indicates that a sizeable number of PhD holders are engaged in activities which are either unrelated to their specialization or are partly related. While studying the job specialization and the area of work among the PhD holders in the bracket of below 30 years and other categories, the survey reveals that with the advance of age the matching between the job and the specialization has increased.

### **Research papers, patents and technical publications**

17. PhD holders, as mentioned earlier, are the source of creating new knowledge. They do so, no doubt, while carrying on the research work leading to the PhD Degree. Equally important is that they sustain interest in research work even afterwards. Indicators for such a sustenance of interest in research work could be publishing of research papers, filing of patents or new designs and writing of technical papers subsequent to the PhD Degree. Out of 3200 responses, 2866 scholars furnished necessary information. Analysis showed that 65.3% of the PhDs sustained interest in research even after getting PhDs. This feature was predominantly high in the PhDs in the age group below 30 years. Out of 2866 scholars, there were 344 females. 66.2% of the males and 59% of females reported their interest in research work after PhD. Degree.

### **Status of PhD scholars migrated to overseas**

18. The migration of the scientists and technologists equipped with higher education is a phenomenon which is observed across the countries. The factors for such a migration obviously would vary from country to country. In the Indian context, in various surveys conducted for the premier institutions in the country, certain pull factors and push factors were identified. At the same time, it was also investigated how PhD scholars migrated from the country were employed overseas. The pull factors, push factors and the pattern of employment of PhDs overseas are given below :

#### **Pull factors**

- Better opportunities abroad for employment
- Better academic facilities
- Better career prospects
- Better financial package
- Better working conditions

**Push factors**

- Pressure from the family and friends
- Pressure from seniors
- Poor working conditions
- Poor industrial development, and
- Poor career prospects

**Pattern of employment overseas**

19. Majority (55%) of those who migrated overseas were engaged exclusively in research. The job undertaken by them required PhD as essential qualification. Some of these (33%) reflected that the jobs where they were employed did not require PhD Degrees. As regards the linkages between the nature of work and in the field of specialization is concerned majority of them reported (75%) that there was a match between the field of specialization and the nature of activities they were engaged with. Most of the respondents replied that the desire for creation of knowledge and better career prospects were the major factors pushing and pulling them to go abroad.

20. Some of the research scholars who migrated overseas returned home and started industries in the high technology areas. Desire to serve the motherland and the opportunities provided by the Government for NRIs were the main factors that are instrumental in taking such a decision. Such industries got advantage of their linkage with the foreign partner(s) i.e. the technology link and the availability of the qualified and low cost manpower within the country. There are a number of successful cases.

**Conclusions**

21. The age profile, employment status, waiting period, activity profile, salary profile, type of employer, realization of objectives, matching of qualification with employment and job, migration overseas, sustenance of interest in research can be used appropriately as the indicators to determine the career profile of PhD scholars. The Government of India has used these findings effectively. The findings of the studies on PhD scholars with respect to their career profile and migration of S&T personnel have been instrumental in taking various new programmes and provisions to sustain their interest in research activities leading to creation of new knowledge. Such programmes include 'Bright Opportunities for Young Scientists' in Chosen Areas of S&T, Swarnjayanti Fellowships, Higher Financial payments during and after PhD, Establishment of Centres of Excellence, International collaboration in R&D, Fellowships for women unemployed S&T personnel, Initiating mission mode programmes in high tech areas etc.

**Sources**

1. Study Sponsored by National S&T Management Information System (DST), Govt. of India on "Pattern of Utilization and Career Profile of PhD's in Science and Technology" to IAMR (1991).
2. Study Sponsored by National S&T Management Information System (DST), Govt. of India on "Brain Drain and Career Profile of IIT, Delhi Graduates" to IIT, Delhi (1997).
3. Study Sponsored by National S&T Management Information System (DST), Govt. of India on "Utilization and Career Profile of PGs and PhDs in Science and Technology" to IASST, Guwahati (1998).

## **ANNEX I: LIST OF SCIENCE SUBJECTS**

### **SUBJECT LIST**

1. Agricultural Sciences
2. Anthropology
3. Astronomy and Space
4. Botany
5. Zoology
6. Marine Biology, Environmental Biology, Microbiology, Biological Sciences
7. Chemistry
8. Bio-Chemistry
9. Chemical Technology
10. Computer Sciences
11. Computer Information Sciences
12. Criminology
13. Demography and Population Studies
- 14.1 Engineering – Civil
- 14.2 Engineering – Chemical
- 14.3 Engineering – Communications
- 14.4 Engineering – Electrical
- 14.5 Engineering – Electronics
- 14.6 Engineering – Mechanical
- 14.7 Engineering – Others
15. Geography
16. Geology
17. Geo – Physics
18. Home Science
19. Library Science
20. Mathematics
21. Statistics



- 22. Medical Sciences
- 23. Meteorology and Oceanography
- 24.1 Physics
- 24.2 Nuclear Physics
- 25. Speech and Hearing
- 26. Veterinary Sciences
- 27. Miscellaneous (Demography, Home Science and Population Studies, etc.)