Chapter 1

Introduction

1.1 Rationale

University word is derived from the Latin word “Universitas,” which means ‘specialized associations between students and teachers’. This Latin word referred to Institutions of learning, which granted degrees to its students. The present day Universities are also following the rich tradition of the ancient Universities silently witnessing and accepting changes of time, space and technology. Universities today are much bigger in terms of the subjects taught, faculties and the students. An University is a place where new ideas germinate, strike roots and grow tall and sturdy. It is a unique space, which covers the entire universe of knowledge. It is a place where creative minds converge, interact with each other and construct visions of new realities. Universities are diverse in their design and organization, reflecting the unique historical and socio-cultural settings in which they have grown. Through research and teaching universities create, evaluate and bring about advances in knowledge and culture. The principle of moral and intellectual autonomy from political authority and economic power is ingrained in the very idea of a University. This autonomy ensures freedom in research and training and it is expected that the governments and the society would respect this fundamental principle. Teaching and research have to be inseparable, because the task of the University is not only to impart knowledge to young people but also to give them opportunities to create their own knowledge. University is a place where new ideas germinate, strike roots and grow tall and sturdy. It is a unique space, which covers the entire universe of knowledge. It is a place where creative minds converge, interact with each other and construct visions of new realities. Universities act as a bridge between elites and classes; rural and urban and between man and women. Higher education is perceived as a means to overcome caste and class hierarchy, patriarchy and other cultural prejudices and also a source of new knowledge and skills, a space for creativity and innovations. Higher education is considered as a national responsibility and the government has to make necessary provisions to realize its potentials.

The universities produce relevant research, which can compete with the best in the world through interdisciplinary work in which the sciences, social sciences and humanities work together. Universities act as a foundation of civic and democratic values for social cohesion and purpose. Knowledge created in the universities not only leads to economic growth but also helps to overcome racial and ethnic tensions, dogmatism and religious extremism. Universities should be developed in such a way that there is a better understanding of diverse values, policies, practices, traditions and resources. The students, Faculty and
communities who are not part of formal structures and excluded outside can come and become part of the university system. The higher education communities produce a large amount of research in a multifaceted direction. Research in a University increases the knowledge base through new ideas, innovations, artifacts, discoveries and inventions etc. Through research and teaching universities create, evaluate and bring about advances in knowledge and culture. In fact, teaching and research should go hand in hand, each providing fresh incentives to the other. Teaching and research have to be inseparable, because the task of the University cannot be confined only to impart knowledge to the young people but also to give them opportunities to create their own knowledge.

Higher education is the principal site at which our national goals, developmental priorities and civic values can be examine and refined. Higher education is decisive for developing a modern economy, knowledge society and a vibrant polity. It equips young people with skills relevant for the market and those who are already in employment with skills so that they can rapidly grow in career. It prepares all to be responsible citizens who value a democratic and pluralistic society. Thus the nation creates an intellectual repository of human capital to meet the country’s needs and shapes its future.

1.2 Research in Universities

YashPal (2008) In the report he mentioned about the major responsibilities of academic staff in a modern University and they are teaching (transmission of knowledge), research (advancement of knowledge) and community service (application of knowledge). Active and constant engagement with young minds and hearts of the society implies that the universities are to serve the society as a whole and in order to achieve this considerable investment in continuing education is essential. Universities are supported in these endeavors by the government, as these Institutions of higher learning contribute to the solution of present technological and social problems.

Etzkowitz and Leydesdorff (2000) in their triple helix model, the TH model applied greater emphasis on the role of University-Industry-Government (U-I-G) relations as these relations are crucial for the creation and diffusion of knowledge and technological development of nations. The measurement of research productivity is a regular exercise across the universities, research laboratories and countries globally. Although controversial and often contested, such measurement is regarded as the most important indication of research productivity by academic staff. Assessments of academic Institutions are undertaken at different levels of aggregation (for the institution as a whole, by discipline, by Department or unit and at the level of the individual) with the outcomes used to support decisions of different kinds and different stakeholders.

Liang et al. (2012) This paper focussed the role of Chinese universities in enterprise–University research collaboration. This study focuses on a special aspect of the collaboration of co-authored articles. The two
cases analyzed are: (1) research collaboration between Baosteel Group Corporation and Chinese universities; (2) research collaboration between China Petroleum & Chemical Corporation and Chinese universities. The co-authorship data over the period 1998–2007 were searched from CNKI database, the largest Chinese publication and citation database. The main findings are as follows: the number of articles co-authored by enterprise and University scientists has been increasing rapidly; the share of co-authored articles has been growing; the authors from universities are more possible to be the first authors; as a whole, enterprise–University co-authored articles tend to receive more citations and get downloaded more frequently; a mathematical orientation emerges in the enterprise–University articles. To reveal and describe such a trend the methods of keywords analysis and co-occurrence analysis are applied. The Chinese government’s various policy instruments and support for pushing and improving enterprise University research collaboration are introduced and analyzed.

Martin (1996) mentioned that in US, the Congress in 1993 passed the Results and Performance Act which requires the Federal agencies to establish indicators to assess output, service level and income. Measures of research productivity covering both quantity and quality at a national level support are done so that such information is useful to governments, heads of Departments, deans of faculties and students/scholars interested in their performance in relation to competitors.

1.3 Role of Research Productivity in Higher Education

Research productivity in higher education relates to both knowledge creation and knowledge dissemination through its various forms of research, teaching and outreach activities. Research productivity forms a very distinguishing part of the universities and as a consequence, the rankings of academic Institutions based on research productivity have become increasingly important. If Arts satisfy our emotional needs Science satisfies our intellectual needs and Technology augments the means for our survival. If innovation lies at the heart of a developed economy and we want higher education Institutions to have an impact on society at large, then we need to find assessment methods that recognize and encourage engagement as well as scholarship. Research covers a wide range of activities, from carefully designed studies by independent University researchers to analysis of data for particular administrative or political purposes. Rewarding the quality research productivity at higher education Institutions forms the basis for sustaining current research and promoting research and other knowledge output required to meet the national development needs. As research is a central function the University must evaluate its performance.

Data on research performance helps to inform strategic decisions about what areas of research to support or build. It also helps the University leaders understand the institution’s position relative to global and domestic standards of research production. It answers to the questions such as how research is conducted, its impact, number of articles published in core journals by the faculty members in their respective fields, trend of the
publications whether it is increasing or decreasing, patents granted, technology transfer etc and analysis of the research problems both subject wise and discipline wise etc

Martin (1996) Evaluations and assessments of public funded research were first introduced in UK. In 1993 the Congress in US passed the Results and Performance Act which requires Federal agencies to establish strategic planning and performance measurement. This requires establishment of performance goals and performance indicators to assess productivity, service level and outcome.

In UK Higher Education Funding Council intend to reward the ‘world class’ research. The rising cost of research has always put pressure to the administrators for the maximum utilization of resources at a minimum price. This calls for evaluation and assessment of the existing infrastructure by the funding bodies. Research is one of the three missions of modern Universities and its evaluation is becoming stronger in worldwide universities. Developing countries are trying to develop world class universities through intense research fund increases and incentive policies. In many universities of US and UK there is a section/Department that performs the function of measuring research productivity of Departments, Faculty Members etc. The Centre for Measuring University Performance (MUP) of University of Florida, provide objective data and analyses research performance in traditional disciplinary subject areas and in interdisciplinary areas for the purpose of strengthening the quality and impact of research. It brings out the annual report titled The Top American Research Universities. In Australia the link between research funding and research productivity is already in place for decades. Research Quality Framework (RQF) Preferred Model is maintained by the University of Adelaide. The aim of the RQF initiative is to develop the basis for an improved assessment of the quality and impact of publicly funded research. Spanish scientists are supplemented with salary increment for increasing their productivity in English language international journals.

1.4 Indicators of Research Productivity

These days there is growing trend to rank academic Institutions, which has assigned significant value to research productivity as a measure of institutional standing, academic reward and budgets both at national and international fronts. The indicators are of great concern as a suitable unit of measurement for research productivity. Some of the widely used indicators of research productivity are given below:

Peer Review Process

Peer review is the oldest system of research evaluation of Institutions and individuals done by the panel of peers and experts in a particular discipline or field of study.
Meek and Lee (2005) According to them peer review is applied in a variety of settings including research funding applications, articles submitted for publication and job applicant selection. An advantage of the approach is that “a well informed insider will be able to spot trends far sooner than the impartial outsider”.

In some disciplines peer review is the only performance indicator. The results of peer review are very relevant when the review is done by the disciplinary expert who is best to make judgments about quality in his/her area of research expertise. Peer review is a fundamental aspect of the academic process and the internal professionals judge and are responsible for the quality of the knowledge produced and managed. In spite of many merits of peer review, assessment depends on the judgment of peers and a matter of subjectivity is always present. As such peer review process is a partial indicator of contributions to scientific progress. However a blend of peer-review and bibliometrics method is successful for measuring performance. Many Institutions involved in performance evaluation use both the technique for measuring performance.

**Bibliometric techniques**

Here research productivity of Faculty Members can be measured in the form of citations received to the formal and informal publications such as books, journal articles, lectures notes, conference deliveries, licenses, patents, designs and trademarks, monographs, research reviews etc.

Reuters (2008) Bibliometrics is the application of quantitative analysis and statistics to publications such as journal articles and their accompanying citation counts. Quantitative evaluation of publication and citation data is now used in almost all nations around the globe. Bibliometrics is used for research performance evaluation in universities and government labs. Policymakers, research directors, administrators, information specialists, librarians and researchers can use the analysis at individual level. Analysts in many nations issue bibliometric reports at regular intervals called science indicators studies. National Science Foundation (United States), the European Commission, L’Observatoire des Sciences et des Techniques (France), National Institute for Informatics (Japan). Active bibliometrics groups include Argentina, Australia, Belgium, Brazil, Chile, China, Israel, Italy, New Zealand, Portugal, Spain, Sweden, Switzerland and Taiwan. The Netherlands is a world leader in the funding of national research by means of bibliometric measures.

Garfield (1998) In 1998, Garfield himself estimated that citation data and analysis were used in USA to evaluate 5,000 Departments at the leading universities. The Research Excellence Framework of UK conducted a study on the citation count on journal articles and looked up on the ISI Web of Science using
customised software developed by the research team. And resulted in a matching of 79.13% (112,201 from 141,789) of the journal articles included in the Web of Science.

Citations are the essence of science, in the last decade several database producers have came and successfully built up and maintained citation indexing and manually added cited references. The discipline-oriented databases Chemical Abstracts produced by the American Chemical Society, MathSciNet by the American Mathematical Society and PsycINFO by the American Psychological Association have introduced citation indexing to their bibliographic databases. Even though indexing of cited references is still a very laborious and expensive task various studies are done and found empirically that citation data analyses are used for assessment of individual contribution to their research work. These studies are further extended to assess between and across departments, Institutions, countries, gender etc.

Thomson Reutors (2008) In the report Eugene Garfield’s mentioned the reasons for citing a paper and they are:

• Paying homage to pioneers.
• Giving credit for related work (homage to peers).
• Identifying methodology and equipment.
• Providing background reading.
• Correcting one’s own work.
• Correcting the work of others.
• Criticizing previous work.
• Substantiating claims.
• Alerting researchers to forthcoming work.
• Providing leads to poorly disseminated, poorly indexed, or uncited work.
• Authenticating data and classes of fact (such as physical constants).
• Identifying original publications in which an idea or concept was discussed.
• Arguing against the work or ideas of others.
• Disputing the claims of others to have been first with their work.
Neuhaus and Daniel (2008) discussed the Information Communication and Technology revolution and the availability of scholarly documents as it is now possible to automate vast data resources at relatively low cost. Bibliographic databases were established that automatically extract bibliographic information and cited references from electronic documents retrieved from digital archives and repositories. Some databases offer sophisticated features for citation searching and provide detailed information on download frequencies, that serve as an additional basis for assessing the resonance and impact of publications.

In addition to citation indexing of traditional bibliographic databases some of the major sources of citation data are

1. Web of Science
2. CiteSeer
3. Scopus
4. Google Scholar
5. Scifinder Scholar
6. Faculty of 1000
7. SMEALSearch
8. RePEc

Teaching
Teaching is an important part of an University education system. Faculties are evaluated over a period on the basis of research supervisions such as PhD, MPhil, Associates, PG students. Faculty Members also guide to prepare the curriculum at UG level, provide consultation/technical guidance to many Public and Pvt. Institutions.

Research Projects
Research Projects or Grants can be used to determine the research quality of the Institutions. The number and value of research grants and contracts gained provides a better picture for understanding for research quality, as one must have good research capacity to win a research grant or contract. Research grants is an evidence about the quality of the Department for which granting bodies give funds, to high-quality researchers who have excellent track records in producing vital research. University Grants Commission (UGC) promotes teaching and research in emerging areas in Humanities, Social Sciences, Languages, Literature, Pure Sciences, Engineering & Technology, Pharmacy, Medical, Agriculture Science, etc. UGC released grant of Rs. 52.18 crore in Major (804) and Minor (110) projects in Engineering and Technology in 2009-10. UGC released grant of Rs. 20.77 crore in Major (500) and Minor (69) projects.
Martin (2006) mentioned in his work that Faculty Members in mathematical sciences can be evaluated on the basis of research projects undertaken and completed. Some more indicators that he suggested are:
Prizes, fellowships and awards, particularly those won in international competition;
Invited fully- or partly-funded visits to leading research centers and institutes;
Membership of editorial boards of international journals;
Membership of the organizing committee or advisory board of prestigious international conferences;
Scholarly activity such as reviewing and refereeing;
Assessing research theses and research grant applications,
and production of (documentable) widely-used software packages.

**Number of Publications**

The publications are the most valid, fair and direct measure for research performance. It is the total of publications by the scientists or researchers or Faculty Members of a country, institution, subject in the certain period under observation. The number of journal articles, books, conference papers, chapters of books etc published is most valued indicator. This indicator is used by all the Institutions for measurement of research performance.

Li (2012) mentioned that research performance is an important consideration for every ranking system, they’re usually measured by different indicators. Times rankings use normalized average citations per paper to measure the research influence of Universities, while citations per Faculty were used in the QS rankings to indicate the research strength. ARWU rankings put more emphasis on the quantity of scientific research output like the number of papers published in Nature and Science and the number of papers indexed in Science Citation Index-expanded and Social Science Citation Index. In Chinese regional University rankings, research performance is mainly measured by research outputs such as the number of publications, the number of patents granted, etc. In his study he included six indicators indexed by Web of Science covering 11 years from 2000 to 2010 and they are

1. Number of papers P
2. Number of ESI fields F
3. Total citation counts C
4. Citations per paper CPP C/P as shown in ESI
5. Normalized citation impact
6. Hirsch-index
Meek and Lee (2005) in their study discussed and mentioned that broadly there are two categories of performance indicators firstly quantitative (based on number of publications) and secondly qualitative (based on the importance of publications). In their study they used 7 indicators for performance evaluation and they are:

1. Bibliometric data;
2. Awards to individual researchers;
3. Research student data;
4. Research Faculty data;
5. Research income from external sources;
6. Research commercialization performance data; and
7. Outcomes from peer review processes.

Some other indicators for Faculty Members evaluation on the basis of literature studied are

- International exposure of the Faculty Members and students.
- Income generated from University –industry collaboration.
- NGO, Private sector funding.
- Contributions to the wider society.

1.5 Major Agencies for Evaluating Research Productivity

The last decade witnessed the emergence of many ranking systems for research evaluations. Due to globalization, countries as well as universities are open for all and the universities use the rankings for promotional events. Websites of the universities regularly display the rankings, some of the major agencies for evaluating research productivity are

1) Thomson Scientific promotes their Essential Science Indicator (ESI) product as an “in-depth analytical tool that offers data for ranking scientists, Institutions, countries, and journals”. H-index is used to evaluate the quality of individual authors based on the citations to the papers.

2) Shanghai Jiao Tong University Higher Education Academic Ranking of World Universities (ARWU). Since 2003 the Academic Ranking of World Universities (ARWU) is published annually by the Institute of Higher Education, Shanghai Jiao Tong University (http://www.arwu.org). It is the first ranking with
an intended worldwide coverage that focuses in the academic or research performance of universities. The indicators include the alumni and staff winning Nobel or similar prestigious prizes, highly cited researchers in major research fields, articles published in selected top journals, articles indexed by the citation indexes produced by Thomson-ISI and performance per capita.

3) Times Higher Education rankings (THE-QS). The THE-QS World University Rankings (THE-QS) is the only world ranking produced by a private company, Quacquarelli Symonds Limited that started to publish the rankings in 2005. The ranking (http://www.topuniversities.com) is compiled based in six distinct indicators and they are academic prestige based on a large number of respondents, results from an employer survey, the student Faculty ratio, citations per capita according to the Elsevier Scopus database and the proportions of international professors and international students. Before 2007, they derived the citation counts from the ISI Citation indexes.

4) Web Ranking of World Universities (WR) The Web Ranking of World Universities or Webometrics Ranking (WR) is done since 2004 (Aguillo et al. 2006, 2008) by the Cybermetrics Lab, a research group of the Spanish National Research Council (CSIC). They use web data extracted from commercial search engines, including the number of webpages, documents in rich formats (pdf, doc, ppt & ps), papers indexed by Google Scholar (indicator added in 2006) and the number of external in links as a measure of link visibility or impact (http://www.webometrics.info).

5) National Taiwan University Ranking (NTU Ranking) – The overall rankings of performance ranking of scientific papers for world universities started from 2007. It is also known as NTU Ranking. NTU Ranking provides overall rankings, rankings by the six fields and rankings by 14 selected subjects of the top 500 universities. The ranking was first published in 2007 by Higher Education Evaluation and Accreditation Council of Taiwan (HEEACT) and which utilized more objective methods and statistics to rank universities. This rankings system is designed to assess academic performance for research universities by using objective indicators to evaluate their achievements in scientific research. The ranking system evaluates the performance of scientific papers and the indicators are designed to compare both the quality and quantity of scientific papers in each University.

6) Many universities have a section or Department to measure the research productivity for Faculty Members, Departments and by discipline. The Centre for Measuring University Performance (MUP) of University of Florida, Research Quality Framework (RQF) Preferred Model maintained by the University of Adelaide and accepted by the Australian Government.
1.6 India’s Research Productivity

Indian higher education system is one of the largest education systems in the world after US and China. After independence, government has taken various initiatives such as the Scientific Policy Resolution (1958), the Technology Policy Statement (1983) and Science and Technology Policy (2003). At the time of independence, there were only 20 Universities and 500 Colleges in the country with 2.1 lakhs students in higher education. Now in 2011-12 it has increased to 29 times in the case of the Universities, 71 times in the case of Colleges and has gone up to 97 times in the case of student’s enrolment in the formal system of higher education.

As on 31.03.2012 the network includes Universities (Central, State, State Private, Deemed to be Universities and four Institutions established under State Legislation) and colleges in the Higher Education sector. So far the number of universities is concerned, Tamil Nadu tops the list with 55 universities, followed by Uttar Pradesh (54), Rajasthan (47), Andhra Pradesh (43), etc.

**Central University:** A University established or incorporated by a Central Act.

**State University:** A University established or incorporated by a Provincial Act or by a State Act. State universities are meant to be the responsibility of State Governments to maintain and develop. Although majority of students get enrolled here but state universities are treated very shabbily in the matters of allocation of funds or creation of facilities. Even though State Universities are primarily the responsibility of States but for the development of all young people, either in a state-run Institutions or in a central Institutions is a national responsibility and there cannot be any discrimination between the two.

**Private University:** A University established through a State/Central Act by a sponsoring body viz. A Society registered under the Societies Registration Act 1860, or any other corresponding law for the time being in force in a State or a Public Trust or a Company registered under Section 25 of the Companies Act, 1956. The absence of any significant expansion in different sectors of higher education by the State has created a space for the growth of private providers.

**Deemed-to-be University:** An Institution Deemed to be University, commonly known as Deemed University refers to a high-performing institution which has been so declared by Central Government under Section 3 of the University Grants Commission (UGC) Act, 1956.

**Institution of National Importance:** An Institution established by Act of Parliament and declared as Institution of National Importance.
**Institution under State Legislature Act**: An Institution established or incorporated by a State Legislature Act.

The category wise distribution of universities is given in the Table 1.1 below

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Type of Institutions</th>
<th>No. of Institutions (As on 31.03.2012)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Central Universities</td>
<td>44</td>
</tr>
<tr>
<td>2.</td>
<td>State Universities</td>
<td>286</td>
</tr>
<tr>
<td>3.</td>
<td>State Private Universities</td>
<td>111</td>
</tr>
<tr>
<td>4.</td>
<td>Institutions estab. through State Legislation</td>
<td>4</td>
</tr>
<tr>
<td>5.</td>
<td>Institutions deemed to be universities</td>
<td>129</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>574</td>
</tr>
</tbody>
</table>

University Grants Commission (2012) in the report mentioned that plan grants (4721.43 crores) released during 2011-12, 46.84% had gone to Central Universities, 2.44% to Deemed Universities, 20.25% to state universities and 6.33% to Colleges of State Universities.

During the academic session 2011-2012, the total enrolment in all courses and levels in regular stream stood at 203.27 lakhs including 86.72 lakhs women students, constituting 42.66%. The maximum number of students had been enrolled in the state of Uttar Pradesh (29.11 lakhs), followed by Maharashtra (24.14 lakhs), Andhra Pradesh (19.98 lakhs), Tamil Nadu (18.55 lakhs), etc. and Sikkim State had the lowest enrolment of 12,757 amongst states. The student’s enrolment in terms of percentages is given in the next page in Table 1.2
Table 1.2: Students Enrolment in 2012

<table>
<thead>
<tr>
<th>Level</th>
<th>UG</th>
<th>PG</th>
<th>Dip./Cert.</th>
<th>Research</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of total</td>
<td>85.87</td>
<td>12.26</td>
<td>1.08</td>
<td>0.79</td>
</tr>
<tr>
<td>enrolment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

University Grants Commission (2012)

About 156.02 lakhs under-graduate students are in the affiliated colleges and 17.99 lakhs post-graduate students are in remaining University Departments and their constituent colleges. About 1.61 lakhs research students are in the universities.

Out of the total enrolment of students (203.27 lakhs), 37.09% students are in the Faculty of Arts, followed by Science 18.64% and Commerce 17.57% respectively. While the remaining 26.70% enrolment are in the professional courses. This uneven distribution is an indicator of policy change.

The number of research degrees Ph.D. and M.Phil. awarded during 2010-2011 are 16,093 and 12,549 respectively. Out of these, the Faculty of Science had the highest number with 5232 Ph.D. Degrees and 4451 M.Phil. Degrees followed by the Faculty of Arts with 5037 Ph.D. Degrees and 4739 M.Phil. Degrees.

Funding for education and research is greater than before and in the 12th Five-year plan, there is a four-fold increase for education compared to the 11th plan. The vision of the 12th Five year plan for Indian higher education is to achieve further access to higher education through a mission mode national programme by creating new universities and increasing the intake capacity of the existing universities and colleges. Equity and inclusion is done by bridging regional imbalances and disparities across disciplines and tries to address spatial, economic, social and technological needs of the country. Enhancing quality and excellence in all spheres of higher education by increasing the student intake, Faculty enrichment, curricular and evaluation reform, revamping governance structures, greater emphasis on research and innovation by creating efficient regulatory framework.

Many policy changes are taken to fulfill the three E’s (Expansion, Equity and Excellence) motives of 12th plan. For expansion, the target in XII plan is to create enrolment capacity by 10 million, with 1 million for distance learning. This would help an additional 3 million students of each age cohort (18-23) to enter the
higher education stream and raise GER by 27% by 2017. There is a scheme of open model colleges in educationally backward districts. The target is to set up 50 new universities, 500 new colleges and 30 new engineering colleges under this scheme. (University Grants Commission, 2008) GER is a gross measure that includes all enrolled in higher education proportionate to population in the relevant age group (18-23 years). Literacy rates are substituted by GER in higher education for identification of the Economically Backwards Districts for the purpose of planning and allocation of funds in the context of higher education. The following formula defines GER (higher education):

\[
\text{GER} = \frac{\text{All Enrolled in Post Higher Secondary Classes}}{\text{Total Population in 18-23 age groups}} \times 100
\]

For equity, efforts include establishing 374 model colleges in educationally backward districts, improving enrolments in general, special efforts to deal with problems of geographically backward area, women and backward classes, central and state run schemes and scholarships. To provide equitable access and educational opportunities in higher education to the different social, religious, occupational and economic groups living both in rural and urban areas is a major challenge before the policy makers for nearly six decades since the independence.

Caste-based stratification of Indian society and the ways in which it permits (or prohibits) distribution of social goods, services and opportunities has posed a major area of concern in the process of educational development in India. There are differences before the planners due to the various religious groups, the agricultural and non-agricultural population, gender inequality is there as women in each category of population continue to be behind significantly in comparison to their male counterparts. The task of the planners and policy makers is to create enabling conditions so that all deprived social groups, religious and linguistic minorities, the landless and poor wage earners could be brought within the ambit of education in general and higher education.

Planning Commission. (2013) In the report the major criteria is to attain excellence in teaching (learning environment, student teacher ratio, curriculum quality), research (volume, technology transfer, income from research) and citation (research influence). Another parameter of judging quality is employability and employer satisfaction. The Table 1.3 below presents some of the aspects about the quality and gap in each University.
### Table 1.3: Quality and Gap in each University

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Avg. Of all Universities</th>
<th>A Grade Universities</th>
<th>Quality Gap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Departments Per University</td>
<td>29</td>
<td>34</td>
<td>5</td>
</tr>
<tr>
<td>Number of Sanctioned Faculty Positions per University</td>
<td>287</td>
<td>432</td>
<td>145</td>
</tr>
<tr>
<td>Number of filled up Faculty position per University</td>
<td>220</td>
<td>329</td>
<td>109</td>
</tr>
<tr>
<td>% of Faculty positions vacant</td>
<td>25%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Number of Faculty Members with PhD</td>
<td>158</td>
<td>432</td>
<td>274</td>
</tr>
<tr>
<td>Number of Teachers per Department per University</td>
<td>8</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>Number of Books in Library</td>
<td>288913</td>
<td>352886</td>
<td>63973</td>
</tr>
</tbody>
</table>

Planning Commission (2013)
Table 1.4 : Major inputs of Higher education

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>India (Area)</td>
<td>3287 km</td>
</tr>
<tr>
<td>2</td>
<td>India (Population)</td>
<td>1.2 billion</td>
</tr>
<tr>
<td>3</td>
<td>No of Researchers</td>
<td>1,54,827</td>
</tr>
<tr>
<td>4</td>
<td>Indian economy</td>
<td>1337 $</td>
</tr>
<tr>
<td>5</td>
<td>UGC grant (Research)</td>
<td>Rs 3439.95 crores(73.5 crores)</td>
</tr>
<tr>
<td>6</td>
<td>Degree awarded</td>
<td>16,093 (M.Phil), 12,549 (Ph.D)</td>
</tr>
<tr>
<td>7</td>
<td>Faculty</td>
<td>University-1.60 ,Colleges- 7.76 (lakhs)</td>
</tr>
<tr>
<td>8</td>
<td>Expenditure per student on Higher Education</td>
<td>Rs 18600</td>
</tr>
<tr>
<td>9</td>
<td>UGC Expenditure on infrastructural development</td>
<td>Rs. 5 crore each University</td>
</tr>
<tr>
<td>10</td>
<td>Gross Enrollment Ratio</td>
<td>15%</td>
</tr>
<tr>
<td>11</td>
<td>Gross expenditure on R&amp;D in 2011-12</td>
<td>72,620.44 crores (0.87%)</td>
</tr>
</tbody>
</table>

Human Resource Development (2011) and Department of Science and Technology (2012)

Human Resource Development (2011) and Department of Science and Technology (2012) As per the reports the Table 1.4 and Table 1.5 below provide a numerical description of the Indian Higher education system. The input is in the form of manpower, funds, infrastructure and the corresponding output is in the form of publications, patents and journal impact at the world level.

India is considered as a sleeping giant and if the research capacity and experience are moved in a right direction it can compete with other nations in a brief period. According to Adams, King and Singh (2009)
in 1981, India accounted for just above 14,000 papers in the Thomson Reuters database. In the period of 2004-2009, India produced 126,000 papers, constituting 2.75% of the world’s papers published in journals indexed by Thomson Reuters. If this trajectory continues then India’s productivity will be on a par with most G8 nations within 7-8 years and can overtake them between 2015-2020. India’s strength lies on the subject areas of Chemistry followed by Agricultural Sciences, Pharmacology, Microbiology, Pharmacology & Toxicology, have accounted for notable high quality publications.

Ministry of Commerce (2011). Intellectual Property Rights (IPR) are considered to be the backbone of any economy and their creation and protection is essential for sustained growth of a nation. The Table 1.5 below shows in detail about the trend of Patents filed, examined and granted in India during the last 6 years.

**Table 1.5: Patents Growth**

<table>
<thead>
<tr>
<th>Year-Filed</th>
<th>2005-06</th>
<th>2006-07</th>
<th>2007-08</th>
<th>2008-09</th>
<th>2009-10</th>
<th>2010-11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filed</td>
<td>24505</td>
<td>28940</td>
<td>35218</td>
<td>36812</td>
<td>34287</td>
<td>39400</td>
</tr>
<tr>
<td>Examined</td>
<td>11569</td>
<td>14119</td>
<td>17751</td>
<td>10296</td>
<td>6069</td>
<td>11208</td>
</tr>
<tr>
<td>Granted</td>
<td>4320</td>
<td>7539</td>
<td>5316</td>
<td>6061</td>
<td>6168</td>
<td>7509</td>
</tr>
</tbody>
</table>

Ministry of Commerce and Industry. (2011)

India’s strength in patent lies in the fields of Information Technology, Drugs and Pharmaceutical, Space Research, Biotechnology, Entertainment and several other emerging fields.

Out of the total 16,093 Doctorates in the country, 8,302 (51.6%) Doctorates were from the S&T discipline during 2010-11. The national share of universities in scientific publications in the year 2010 has been estimated at 31%, which had been earlier assessed at 15% in 2003. Average citations per paper of publications from the Institutions supported by DST exceed the national average of 3.4.

Department of Science and Technology (2012) had commissioned Thomson Reuters to show, through objective analysis, India’s strengths and weaknesses in science and technology, and key areas in which India can achieve tremendous progress. Thomson Reuters presented “Evidence” that report a large volume of data and trends in research outputs from India. Evidence is based on the scientific publications covered under the Science Citation Index SCI databases. The Table 1.6 below provides the important facts and figures about India’s research output.
The current status of higher education in India is characterized by low enrolment, poor completion rates and high drop out. There are wide social and regional disparities in enrolment rates and availability of Institutions of higher education. India has made appreciable progress in this regard, particularly with reference to growth in the number of universities and colleges over the years, improving infrastructure such as teaching Faculty, hostels, housing for teachers, library, laboratories, and computer facilities etc. over the years.

The colleges and universities located in remote and backward areas are poor on all parameters of educational development. It is therefore necessary to consolidate the infrastructural provisions in existing universities and colleges besides strengthening the supply of colleges and Institutions of higher and vocational education in order to provide higher and better quality opportunities to eligible population to join higher education.

1.7 Statement of the problem

Universities conduct research worldwide to create, transfer and utilize knowledge to find solutions for the scientific, technological and social problems prevalent in the society. Research has a central place in

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Description</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Total no. of publications</td>
<td>65,487 Scopus, 40,711 SCI</td>
</tr>
<tr>
<td>2.</td>
<td>India’s share in global research publication</td>
<td>3.5%</td>
</tr>
<tr>
<td>3.</td>
<td>Total no. of patents</td>
<td>39400</td>
</tr>
<tr>
<td>4.</td>
<td>Citation impact</td>
<td>0.68%</td>
</tr>
<tr>
<td>5.</td>
<td>No. of Indian papers in top 1% impact making journals</td>
<td>4723</td>
</tr>
<tr>
<td>6.</td>
<td>India’s share of GDP/R&amp;D</td>
<td>0.87%</td>
</tr>
</tbody>
</table>

Department of Science and Technology (2012)
University education system and about one third of University budget goes for research funding. Research is one of the three missions of modern universities and its evaluation is becoming stronger in worldwide universities. As most world-class universities are Research universities (RU). Developing countries, are trying to develop world class RU through intense research fund increases and incentive policies. In many universities of US and UK there is a section/Department that performs the function of measuring research productivity of Departments, Faculty Members etc. The Centre for Measuring University Performance (MUP) of University of Florida, provide objective data and analyses research performance in traditional disciplinary subject areas and in interdisciplinary areas for the purpose of strengthening the quality and impact of research. It brings out the annual report titled *The Top American Research Universities*. In Australia the link between research funding and research productivity is already in place for decades. Research Quality Framework (RQF) Preferred Model maintained by the University of Adelaide. The aim of the RQF initiative is to develop the basis for an improved assessment of the quality and impact of publicly funded research.

Reuters (2008) Mentioned that counting, measuring, comparing quantities and quantitative analysis are the main tool of science. Scientific research, recording and communicating research results through publications, has become enormous and complex. It is so complex and specialized that personal knowledge and experience are no longer sufficient tools for understanding trends or for making decisions. Yet the need is to highlight significant or promising areas of research and to manage better investments in science. Universities, government offices and labs, boardrooms must decide what research should be supported and what should not, or which research projects and researchers should receive more support than others.

Bird (2005) The working committee report analysed the importance of performance indicators by the UK government. To assess the impact of Government policies on well performing or underperforming Institutions and public servants to play the role for public accountability of Ministers. A Performance Monitoring protocol cover objectives, the definition of performance indicators, design considerations, procedures for data collection, analysis, presentation of uncertainty and adjustment for context together with dissemination rules is explicitly defined. The Royal Statistical Society considers that attempts to educate the wider public and policy makers about the issues surrounding the use of performance indicators.

Universities can fetch up more finance from governments by increasing their research productivity hence forth evaluation of research performance is of paramount importance. More important is the evaluation of the research performance. Data on research performance helps to inform strategic decisions about the areas of research to uphold. Research performance evaluations are done by University administrators, Government offices and laboratories to rank the institution’s standard to national and international level. The measurement of research productivity is crucial these days for career advancements, promotions, Departmental and institutional ranking, a measure for R&D, assess market-oriented innovations, economic
growth etc. On the basis of research productivity institution’s strategic decisions are taken to set priorities, staff and fund allocation. Students use the rankings of Departments and Institutions for further education, learning and research.

Martin (1996) mentioned about the 4 reasons why there should be assessment of government funded research and they are:

Firstly due to the growing costs of scientific instruments, facilities and infrastructure, Secondly to manage the funds for research, Thirdly to balance between the new emerging areas and the declining areas of scientific research and finally public accountability so that the public money is well spent.

Statistics is the science of collecting and analyzing data, in order to base decisions on them. It is a branch of scientific method used in dealing with phenomena that can be described numerically either by counts or by measurements. The different stages for the organization of numerical data are collection, organization, presentation, analysis and interpretation. The methods by which statistical data are analysed are called statistical methods, the mathematical theory which is the basis of these methods is called the theory of statistics or mathematical statistics.

Statistical methods are applicable to wide variety of fields – from astrostatistics to econometrics, from business statistics to medicine, from social statistics to actuarial science for risk assessment, from agriculture to engineering statistics etc. Statistics is usually not studied for its own sake but it is employed as a tool for analysis of problems in natural, physical and social sciences. The subject statistics is widely used in practice, the various statistical methods are used to study various subjects such as economics, commerce, physics, astronomy, life science and all other branches of knowledge. Job opportunities in statistics are plentiful and projected to increase worldwide. Both the theoretical and applied aspects of statistics are used by Government, laboratories, scholars, policy makers and the common man. After IT, statistics is the only subject that is used as tool to study other subjects. This study is an attempt to know the departments which provide best teaching and research in the Central Universities, to know the number and growth of publications in the subject of statistics, projects completed, collaboration pattern among the authors, citations to the publications etc the topic Research Productivity of the Departments of Statistics in the Central Universities in India: a bibliometric study is taken as the study. Such kind of study can also be implemented in other kind of subjects to know the publication pattern in a particular subject.
1.8 Objectives of the study

The objectives of this study based on the scientific indicators are to:

1. To find out the research productivity of 11 departments among the 44 departments that exist in the 44 central universities in India.

2. To find the refereed research output of the Faculty Members engaged in the 11 departments of the 11 central universities covered under the study.

3. To find the publication pattern of Faculty Members with regard to projects completed in the 11 departments of the respective 11 central universities.

4. To find the correlation between faculty size and total publications, faculty size and referred publications.

5. To determine the trend of publications in the succeeding years.

1.9 Methodology of the study

The present study taken up by the scholar is an evaluator study. For the study the scholar have identified 44 central universities that have the department of statistics and it was found that in the initial stage there are 11 central universities that have the department of statistics.

The total population of 82 faculty members working in the 11 central universities spread all over the country were contacted at the first stage. The relevant information were collected through questionnaire, interview and respective webpages of the faculty members. The survey started from 20 July 2011 and ended by April 2013 and 74 variables were grouped under five broad categories. The five categories are basic details, departmental details, publication details, referred publications and research problems. An excel sheet was prepared for data entry. The scholar used various statistical tools like : Simple Mean, Correlation Coefficient and Least square method were used for data analysis.

1.10 Hypothesis

Following are the hypothesis of the study:

1. Research output is directly proportional to the length of service of the Faculty Members.

2. The focus area of research changes in the faculty’s career graph and there is a gradual growth in the publication as the author gains more experience in his field.
Hypothesis 2 is a composite statement “The focus area of research changes in the faculty’s career graph and there is a gradual growth in the publication as the author gains more experience in his field.” The second composite statement has similarity with hypothesis 1. However, while working on the project the researcher focused in the first part of the composite statement only. In other words, the researcher studied the change in focus area of the faculties in chapter 4 section 4.3.3 and tested hypothesis 2.

The second part of the composite statement was not attended any further as it was already covered under hypothesis 1 and was taken care in Chapter 4 section 4.5.

1.11 Definition of Terms

Central University: Institutions set up by the Central Act of Government of India. Higher education Institutions that are organized and controlled by UGC. Although each University operates under a separate charter with some freedom. The Government through the Ministry of HRD and UGC holds ultimate authority over Central Universities.

Experts: A full-time academic lecturer who is mainly engaged in working in a high status position in the University. Experts will therefore include the President, Deans, Professors, Assistant Deans, Associate Professors.

Faculty Members/ Academic staffs: Full-time tenured University lecturers who are mainly responsible for teaching, research and academic service (advising students and performing professional duties). They can be Professors, Associate Professors, Assistant Professors. This does not include part-time lecturers, adjunct professor, visiting professor, temporary Faculty Members and teaching assistants.

Publication: Any activity that aims to make the products of academic research generally known to the public. It is only research published in refereed or non-refereed journals.

Research: Any scholarly research produced by academic Faculty Members that contributes to the knowledge base of a discipline. A research publication in refereed or non-refereed journal, research report for an agency or institution, a monograph and a academic book or book chapter.

Research activity: Any activity that academic lecturers perform when they conduct research such as defining a research problem, carrying out a literature review, collecting data, analyzing data or writing a report.

Research Output: The quantity of finished research works and publications produced by academic lecturers during 2000-2010.

Research Productivity: Total research output compared with inputs such as time and Faculty size during 2000-2010.
1.12 Overview of Chapters in the Theses

Chapter 1 This chapter serves as an introduction to the study, a foundational explanation for the importance of research, research productivity, various parameters for the measurement of research productivity in universities. The reputed agencies and the parameters used by the agencies to rank the universities on the basis of research productivity is also discussed. This chapter discuss about the role of research productivity in Institutions and its importance for the policy makers, administrators, Faculty Members, students, experts. To determine and strengthen the weak subject areas on the basis of research productivity is discussed, strategic decisions taken by government to set priorities, staff and fund allocation is also discussed. Students use the rankings of Departments and Institutions for further education, learning and research. This chapter also served with theoretical background of the study and it concluded with the statement of the problem, the objectives of the research and the significance of the study.

Chapter 2 This chapter acts a background for the development of various models for the evaluation of research performance. An attempt is made in this chapter to review the trends of productivity models in phases. The various indicators of research evaluation are also discussed in detail.

Chapter 3 Here in this chapter an overview of the Universities, Departments, Faculty Members under study are presented. This chapter also gives details about the research methodology, research questions, design and organization of the study. It gives details about the methodological procedures of selected subject, the design of the questionnaire, sampling techniques and the treatment of the data.

Chapter 4 In this chapter the researcher presented the analysis and findings of the study. The quantitative data obtained through questionnaires, interview methods and website about the Faculty Members under study are represented in tables and graphs.

Chapter 5 Here the findings and conclusions of the research study and some suggestions are also given for improving the research output of the Faculty Members.

1.13 Summary of the Chapter

This chapter has provided information that will assist in the planning, progress and formulation of institutional research policies by highlighting those factors that should be emphasized in order to further encourage academic staffs to increase their research productivity.

Nowadays universities are changing their roles. Universities put more emphasis on producing a higher quantity and quality of research productivity. Academic staffs are conducting research in order to enhance
their knowledge and improve the quality of teaching. Their teaching role and research should co-exist in a balance which is supported the Institution, Government, private organizations and the community.

It is a fact that there is still an unacceptably low level of research Productivity in the Universities of India. The current condition of higher education threatens the University’s ability to sustain the condition that supports research achievements. In Indian Universities there are many obstacles that impact on low research productivity which need to be resolved and eliminated if research productivity is to be increased.