Chapter One

Introduction, Objectives, Hypothesis & Methodology
Science and Technology are generally recognized as important strategic factors determining the future development and welfare of nations. The terms "Knowledge society" and "knowledge-based economy" have been recently coined in order to bring into relief this crucial role of scientific knowledge and innovation in economic progress and social development (Fronk, 2003)\(^1\). Science and Technology (S and T) play an important role in the development of nations. Developed countries therefore invest heavily in (S and T) research and development (R and D).

The main measures of scientific development are R and D expenditure, the ratio of gross domestic expenditure on R and D to gross domestic product (GDP), the number of personnel involved in (S and T) research, scientific publication output, and numbers of patents registered in the international patent systems. Among these indicators, R and D expenditure and scientific publication output seem to be the most clearly defined and least controversial. The reliability and breadth of statistical data on which (S and T) indicators are based leave much to be desired (Barre, 1998)\(^2\). Most statistical data (even for the strict domain of scientific research) are not linked to any social, cultural, or economic purpose; for example, the international mobility of scientists or the R and D networks of multinational companies are generally not considered. The standard indicators of (S and T) activity have inbuilt biases that often penalize or under represent work in developing countries. This is due, in part, to the presence of (S and T) activities in
the networks of power that are dominated by the developed countries. Furthermore, each indicator represents only one facet of a complex reality, and often multiple indicators must be examined together to obtain a more realistic picture of each country's (S and T) profile.

Measures of international collaboration are suggesting ways of building (S and T) capacity in the developing world: researchers from advanced countries collaborating with counterparts in developing countries report that these activities make a real contribution towards building international level (S and T) capacity in those countries. Indicators show that collaborative research between scientists in advanced and developing countries is expanding (Wilson and Osareh, 2003). Further, the number of (S and T) publications produced jointly by scientists in these countries is also rising. The governments of many developing countries recognize the critical importance of local institutions and specialists being able to identify, adapt, and effectively use the (S and T) achievements of industrialized nations and to develop their own unique technologies.

Knowledge pertaining to Science and Technology has expanded and advanced at an increasing pace since the end of the last century. The field of Science and Technology has witnessed a qualitative shift in the generation of information and knowledge and its investment has led to significant changes in productive methods. This has had a profound impact on the social and natural environment. The gap between the human capacity to invest Scientific and Technological expertise in meeting ever-increasing demands and safeguarding environmental and social balance has widened. With the end of the century has come the first implantation of the image of scientific and technological dependency. Among the salient features of the end of the twentieth century is the affirmation of the reality of Science and Technology (S and T) as the major pillar of development in its different activities.
Jordan’s concern with (S and T) dates back to an early stage in the evolution of the Jordanian state (Mulki, 2006). The attainment of independence and the stabilization of Jordan’s political entity at the end of the forties were followed by the move towards building a modern state. The development stage of Jordan began in fifties when first investments were made in the exploitation of its natural resources and establish heavy industries depending on the intensified use of the technology available at that time. Beginning of the sixties, witnessed the state to develop the most important resources i.e. manpower with the establishment of the first national university. The developmental process continued with the establishment of the necessary institutions and infrastructure and the growth of productive sectors. At the onset of the seventies, in recognition of the significance of S&T at the highest level of leadership, the Royal Scientific Society (RSS) was established as the first national scientific research center aimed at intensifying national efforts in (R and D), and industrialization as well as providing (S and T) services and participating in the construction of a national scientific and technological base.

With continued economic and social transformation and the move towards evolving developmental tools and their inputs and activating the investment of manpower and national resources available to Jordan, efforts were directed towards the institutionalization of national ambitions in the (S and T) field. Science and Technology assumed its natural place as the essential cornerstone of national development, especially as Jordan is opening up and good relations at the regional and international levels allowed it for remarking the distinct impression of (S and T) on the achievement and rise of societies. The establishment of the Higher Council for Science and Technology (HCST) at the end of the eighties confirmed the interest of the Jordanian state in making Jordan a center of excellence in many fields.
Jordan has adequate infrastructural base for (S and T), especially within the universities and centers of scientific research. Research Development activity in Jordan is still modest, both quantitatively and qualitatively, and in most cases does not serve the developmental effort but is directed to basic or academic knowledge. National expenditure on R and D is still at the lowest level, at best not exceeding 0.35 per cent of the gross national income; whereas the globally acceptable level for developing countries reaches one per cent in accordance with the recommendations of specialized international organizations.

Scientometrics analysis of Science and Technology publications in Jordan provide dependable methods of measuring scientific activity in terms of the output of scientific publications that may serve as one indicator of country's (S and T) activity. Scientometrics, the quantitative study of science and technology through its published literature, uses various (S and T) databases to show, inter alia, a country's share of world's total publication count.

Librarians usually ignore the inclusion of bibliometric in their practical work, though it is very useful for planning of information provision. The reasons behind the non-use of bibliometrics, are time consuming and sometimes difficult to perform; another problem is that the results of bibliometrics studies give a simplified picture of a complex reality and must take into account many variables to be useful in practice (Sara, 1995). The bibliometric methods, however, give opportunities to describe the content, structure and development of research and is becoming one of the most important on the basis of collection development in research libraries. These individuals, who develop library collection, data or information services, would have difficulties in knowing which material should be included especially in case of little concern scientists about the definition of the field. In such cases bibliometrics provide the needed tools for identifying the core
collection in such fields. The vast amount of documents available through many networks gives possibilities to apply bibliometrics within framework of the librarians' daily work.

1.2 STATEMENT OF THE PROBLEM

"Publications in Science and Technology by Faculty Members in Universities of Jordan: A Scientometric Study".

1.2.1 TERMS USED IN THE STATEMENT OF RESEARCH PROBLEM

1.2.1.1. Scientific

a. Pertaining to science or the sciences: scientific studies.

b. Occupied or concerned with science: scientific experts.

c. Regulated by or conforming to the principles of exact science: scientific procedures.

d. Systematic or accurate in the manner of an exact science. (http://dictionary.reference.com). 6

1.2.1.2 Literature

a. Writings in which expression and form, in connection with ideas of permanent and universal interest, are characteristic or essential features, as poetry, novels, history, biography, and essays

b. The entire body of writings of a specific language, period, people, etc.: the literature of England

c. The writings dealing with a particular subject: the literature of ornithology

d. The profession of a writer or author

e. Literary work or production
f. Any kind of printed material, as circulars, leaflets, or handbills:
literature describing company products

g. Archaic Polite learning; literary culture; appreciation of letters
and books.

1.2.1.3. Science

a. The intellectual and practical activity encompassing the
systematic study of the structure and behaviour of the physical
and natural world through observation and experiment

b. A systematically use of scientific knowledge in industry and

c. A branch of knowledge or study dealing with a body of facts or
truths systematically arranged and showing the operation of
general laws: the mathematical sciences.

d. Systematic knowledge of the physical or material world gained
through observation and experimentation

e. Systematized knowledge in general

f. Knowledge, as of facts or principles; knowledge gained by
systematic study

g. A particular branch of knowledge

h. Skill, especially. Reflecting a precise application of facts or
principles and proficiency.

1.2.1.4. Technology

a. The practical use of scientific knowledge in industry and
everyday life.

b. Practical sciences as a group. (Chambers 21st Century
Dictionary, 2004).8
c. The branch of knowledge that deals with the creation and use of technical means and their interrelation with life, society, and the environment, drawing upon such subjects as industrial arts, engineering, applied science, and pure science.

d. The terminology of an art, science, etc.; technical nomenclature.

e. A technological process, invention, method, or the like.

f. The sum of the ways in which social groups provide themselves with the material objects of their civilization.

1.2.1.5. Faculty Members

An educator who works at a college or university.

1.2.1.6. Universities

a. An institution for higher learning with teaching and research facilities constituting a graduate school and professional schools that award master's degrees and doctorates and an undergraduate division that awards bachelor's degrees.

b. The body of students and faculty of such an institution.

c. The buildings and grounds of such an institution.

1.2.1.7. Jordan

a. The official name is: **Hashemite Kingdom of Jordan**, a country in South West of Asia, consisting of the former Trans-Jordan and a part of Palestine till the 1967, which has been occupied by Israel. Its capital is Amman city.

b. Jordan River is a river in South West Asia, flowing from South Lebanon towards the South between Israel and Jordan through west of Jordan into the Dead Sea of 320 km long.
1.2.1.8. **Scientometrics:** Scientometrics is the science of measuring and analyzing science. In practice, scientometrics is often done using bibliometrics that is measurement of (scientific) publications.

1.2.1.9. **Study**

A. Application of the mind to the acquisition of knowledge, as by reading, investigation, or reflection: long hours of study

B. The cultivation of a particular branch of learning, science, or art: the study of law.

C. Research or a detailed examination and analysis of a subject, phenomenon, and so on.

D. A well-defined, organized branch of learning or knowledge.

E. An inquiry, research, reading, thought consideration

1.3 **PURPOSE AND SCOPE OF THE STUDY**

Bibliometrics have been used in novel ways to assist with the evaluation of so many subjects. As the link between science and technology represents a major strategic stake, so the relation between scientific bibliographic reference and technical bibliographic references can be of very important documentary interest. This study is to present the most important modifications in this correspondence, in particular will allow linking several indexation fields with one of the most complete representation of classifications. Bibliometric methods are seldom used by librarians in practical work. The needs to organize this information and to help the user to identify relevant documents grows more important, and at the same time the huge amount of available documents give great possibilities to apply bibliometrics easily and in the frame of practical work. Bibliometrics provide a tool for getting the core for developing a local collection in a new field.
This study deals with the basic elements, that constitute the foundation for bibliometric analyses’ the document being analyzed, and the tools that are applied for the data collection. The concepts of bibliometrics theory and link theory are to be discussed through a study of the current literature. The purpose of this study is aimed at conducting bibliometrics studies on the published output of the faculty members of the Jordanian Government Universities, specifically in the fields of science and technology. The study would be an empirical work in the frame of a project, which could be for instance collection development in an interdisciplinary field. To be more specific, this study deals with the problem of use of bibliometrics in the aforesaid Jordanian universities teaching staff as a retrieval source of information. This study would be the first of its kind to be conducted in the government universities in the field of science and technology in relation teaching staff and this study would try to know the opinions of the concerned staff in the usefulness of such study.

1.4 OBJECTIVES OF THE STUDY

This study aims at identifying and describing some of the characteristics of the literature published in the field of ‘Science and Technology’ over a period of 11 years (1995-2005) with a view to identify most productive authors, core journals, place, time, subject, area and country of origin, from where the documents, are being published.

This study would be of great benefits to the researchers and particularly to those scientists who are engaged in research in science and technology in Jordan Output would give a wide scope to the teachers.
The basic objectives of the present study are as follows:

1. To know the most productive year/years of the literature/journal published on the subject.
2. To identify a list of core journals to study the scattering pattern of literature of the subject in different journals.
3. To determine the authorship pattern in the subject,
4. To find out the more used format of scientific documents.
5. To identify the different languages to know the dominating language in which most of the articles on the subject have been produced.
6. To identify ranked list of periodicals to know the core periodicals containing the most of literature on the subject.
7. To identify the interdisciplinary character of the subject
8. To study the rate of collaborative research that can be effectively measured from the number of authors in papers.
9. To understand most dominating countries in the scientific publications.
10. Assess the growth of the literature

1.5 HYPOTHESIS OF THE STUDY

While making bibliometric analysis, we find it to be of fundamental importance that some specific aspects are kept in mind in order to state clearly, what has to be examined. The following hypothesis has therefore been developed:-

Hypothesis-1

Most of the contributions of the faculty members of Jordanian Universities of Science and Technology are published in the journals brought out from Jordan.
Hypothesis-2
The faculty members like to publish significantly in the foreign journals also.

Hypothesis-3
The faculty members in Jordanian Universities mostly do their researches in newly developed subjects.

Hypothesis-4
Most of the faculty members like to publish in their native language.

Hypothesis-5
The periodicals carrying the publications of faculty members are mostly brought out in Arabic language.

Hypothesis-6
The period of study (1995-2005) shows a steady growth in the production of scientific literature by the faculty members of Jordanian Universities.

Hypothesis-7
The Faculty members of Jordanian Universities prefer to publish their contributions in form of research articles.

Hypothesis-8
The productivity of the authors is linked with the subjects that mostly contribute to the development of Jordan.

Hypothesis-9
The faculty members of Jordanian Universities believe more in collaborative research as compared to individual research.

Hypothesis-10
The bibliometric laws when applied to the published output of the Faculty members of Jordanian universities are found to be valid.
1.6 RESEARCH METHODOLOGY AND PROCEDURES

Scientometrics is used to measure scientific activities, mainly by producing statistics on scientific publications indexed in databases. They are flexible tools used to study the sociological phenomena associated with scientific communities, to conduct scientific/strategic, technical, technological or competitive monitoring, to design and manage research programs and to evaluate research. They are extremely valuable methods for evaluating research output, positioning studies and conducting foresight studies in science and technology.

Scientometric tools can be used to measure and compare the scientific activities at various levels of aggregation including institutions, sectors, provinces and countries. They can also be used to measure research collaborations, to map scientific networks and to monitor the evolution of scientific fields. Scientometric indicators give policy-makers objective, reproducible and verifiable information. Scientometrics specializes in the production and analysis of scientometric data. This expertise enables to extract value-added information on scientific activities from various databases of scientific publications. Scientometrics develops and utilizes advanced scientometric methods (controlled / normalized vocabulary and keyword co-occurrence analysis) to delineate and measure scientific activities in very specific or emerging fields.

In this study, mathematical and statistical methods are used for measuring quantitative and qualitative work published in books, journals and others. By using analysis, it is, for instance, possible to measure the scattering of articles in different journals so as to measure the growth and obsolescence of literature in the field of Science & Technology. The following procedures and methods will be used in the present study.
The methodology for conducting this scientometric study has been diagrammatically represented below:

(A) Selection of Topic

Lot of research in Science and Technology is being conducted in Jordan. But there has hardly been a study to find out the bibliometric or more appropriately Scientometric trends. Hence, the Topic “Publications in Sciences and Technology by Faculty Members in Universities Jordan: A Scientometric Study” has been selected for study.

(B) Selection of Source document

To conduct research on the topic “Publications in Science and Technology by Faculty Members in Universities of Jordan: A Scientometric Study” the data had been collected from comprehensive
and appropriate sources of literature in the field of Science and Technology. They are:-

- Abstract of Funded research projects at the University of Jordan
- Yarmouk University research publications
- Jordan University research publications (Database)
- Database of Arab periodicals “Yarmouk University”
- Funded Research Projects (Jordan University of Sciences and Technology)
- Index Mu'tah studies and research
- Index Dirasat
- Index Abhath al-Yarmouk
- Jordan National Bibliography

(C) Collection of data

The most important task is to select the documents from which data has been drawn on the subject Science & Technology. Research publications, abstracting and Indexing sources, databases, bibliographical sources published from Jordan are consulted for that purpose.

(D) Database Design

To fulfill the information needs, an organization needs to save information about its employees, departments, locations, customers, and invoices. This pieces of information are called data. A database stores data that is useful to us to develop the database. 'Oracle®i Package has been used for the purpose. This package has a number of tools that allow the users to create database object, Forms, Reports, Graphs, etc.
Some of the tools of oracle are:

- SQL/PLUS.
- Oracle Form Builder.
- Oracle Report Builder.
- Oracle Graphics Builder.
- Oracle Designer.

The system contains three main forms as follows:

1- **System Variables**: It is used to define document type, languages, Universities.

![System Variable Form](image-url)
2- **Document Information**: It is used to insert all information about the documents like title, year of publication, language, document type, authors, and subjects.

3. **Inquiry Form**: It is used to inquire about any field of information concerning the document, and can combine more than one fields, such as year of publication and language of document.
The Oracle database also contains many reports and statistics as follow:-

Research by author number,
Research by author gender,
Number of research,
Authors' list,
Subjects' list,
Dynamic statistic report,
Dynamic general report, this report allows user to build his own report by choosing field and determining the condition of report.
Database Tables: - The Oracle can create tables with each and every field. For example-

- Languages
- universities
- Document Information
- Authors
- Document Authors
- Subjects
- Document Subjects

(E) Analysis

Next step is to tabulate and analyze data collected from various sources in order to conduct the following studies-

(i) RANKING OF PERIODICALS:

The main objective of this study is to identify the core periodicals (journals) containing the research "Publications in Sciences and Technology by Faculty Members in Universities of Jordan: A Scientometric Study". To conduct this study, the items published in different periodicals were grouped together and counted. It is necessary to know the most productive periodicals in Science & Technology.

(ii) GEOGRAPHICAL SCATTERING OF ITEMS:

This is done to determine the geographical scattering of items while studying the use pattern of research literature in the subject under study. The database clearly gives the place of origin of each item. The entries were grouped on the basis of their country of origin.
(iii) SUBJECT-WISE DISTRIBUTION:

This analysis has been done to know the scattering of "Publications in Sciences and Technology by Faculty Members in Universities of Jordan" in different subject fields. This analysis shows the interdisciplinary character of the subject field. The analysis has been done on the basis of information given in the field of periodicals publishing the literature.

(iv) LANGUAGE-WISE DISTRIBUTION OF ITEMS:

In this study an attempt has been made to analyse the language-wise distribution of items. Because the articles are published in almost all languages of the world, it is of paramount important to study language-wise distribution of items. This information is available in all standard Indexing and abstracting services. The same information has been used to know dominant languages of publications.

(v) CHRONOLOGICAL STUDY:

In this analysis time of origin of items was studied to know how many items belong to a particular time period on the basis of frequency of items belonging to a given year. The data was analyzed and tabulated to find out the most productive year of items.

(vi) FORM-WISE DISTRIBUTION:

These are varieties of forms of documents in which Publications in Sciences and Technology by Faculty Members in Universities of Jordan appear. There are articles, books, Articles in Conference Proceedings etc. the analysis has been done to know the major form of documents used for producing new information in the subject S&T.

(vii) RANKING OF AUTHORS:

This study has been conducted to know the eminent personalities (faculty members of Jordan Universities) in the field of Science &
Technology. Ranking of authors is done to identify the most productive contributions in the subject. For the purpose, the researcher arranged the entries in the A,B in alphabetical order by the surname of each author. All authors were thus retrieved, arranged and tabulated in the order of decreasing frequency of their contribution to know the most productive authors.

1.7 LIMITATIONS OF THE STUDY

This study is limited to the subjects that are related to Science and Technology such as Physics, Biology, Medicine, Pharmacy, as well as the Technical Fields and Engineering. The study will be conducted on the published output of the faculty members of aforesaid subject fields during the period from 1995 to 2005. The related books and published articles, only those published in English as well as Arabic Languages. Under the study, the scope of topic is limited to the followings government universities:

i. University of Jordan.

ii. Yarmouk University.

iii. Mu'tah University.

iv. The Jordan University of Science and Technology.

v. Al-Balqa Applied University.

vi. AL al-Bayt University.

vii. Al-Hashimiyah (The Hashemite) University

viii. Al-Hussain University.

ix. Al-Tafila Technical University.

x. The German-Jordanian University.
1.8 Data Analysis and Presentation

The data collected is analyzed and presented into tabular form. The main purpose behind it is to draw inferences and prove/disprove the hypothesis and fulfill the stated objectives of the study.

1.9 Chapterization:

The study comprises of eight chapters. Each chapter deals with different aspects of the research work, which is explained below:

Chapter 1: Introduction.

Chapter 2: Development in Science and Technology.

Chapter 3: Development of Higher Education in Jordan.

Chapter 4: Literature Reviews on Scientometrics.

Chapter 5: Scientometrics/Bibliometric Laws.

Chapter 6: Data Collection and Analysis.

Chapter 7: Application of Bibliometric Laws.

Chapter 8: Conclusion: Findings and Policy Recommendations.
REFERENCES:


