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The Evolution of the Interdisciplinarity of Information Science: A Bibliometric Study

by

Imad A. Al-Sabbagh

A Dissertation Submitted to the
School of Library and Information Studies
in Partial Fulfillment of the Requirements for the
Doctor of Philosophy Degree

Approved:

Professor Directing Dissertation

Dean, School of Library and
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THE EVOLUTION OF THE INTERDISCIPLINARITY OF INFORMATION SCIENCE: A BIBLIOMETRIC STUDY

(Publication No._____)

Imad A. Al-Sabbagh, Ph.D.

The Florida State University, 1987

Major Professor: Charles Wm. Conaway

The purpose of this study is to describe the interdisciplinarity of information science on the basis of the reference patterns in the Journal of the American Society for Information Science (JASIS) from the first issue that carried the current title (January, 1970) through the issue of December, 1985, and to identify the changes in the sources of the references in the articles of JASIS during the study period.

JASIS is chosen after the opinions of twenty-five information science experts were surveyed.

It is assumed that the literature of JASIS represents the literature of information science. Experts' opinions, the coverage of the journal, and the fact that JASIS is the official journal of the American Society for Information Science are used to justify this assumption.

The study is designed to answer three research questions:

1. What are the disciplines that contributed to information science between 1970 and 1985?

2. How did the contributions of different disciplines to information science change between 1970 through 1985?

3. Which disciplines are the major contributors to information science literature in the periods 1970-1974, 1975-1979, and 1980-1985?

A ten percent of JASIS references are randomly selected and examined.

Citation Analysis used to collect data for the study. Discriptive statistics was used to analyze data and to present the results and findings.

The major findings of the study are:

1. Thirty-two different disciplines are identified as the contributors to information science during the study period.

2. The contribution of information science to its own literature is the highest, followed by computer science, library science, and science-general (DDC 500-509.999).

3. The contribution of computer science to information science tripled between 1970 and 1985.

4. The contribution of library science to information science decreased from 14.28% of total citations during the first period of the study (January, 1970 through December, 1974) to 9.6% of total citations during the third period of the study (January, 1980 through December, 1985).

5. Other major contributors to the inter-disciplinarity of information science are: psychology, management, chemistry, and mathematics and statistics.

6. During the sixteen years of the study, it is found that the relationship between information science and library science is weakening. On the other hand, the relationship between information science and computer science becomes stronger.

The validity of the current academic affiliations of information science educational programs with different colleges, departments and schools is questioned based on the finding that information science itself is the major contributor to its literature and no other field has contributed as frequently as information science at any time during the period January, 1970 through December, 1985.

TO MY MOTHER,
WHO GAVE ME EVERYTHING I HAVE;

AND TO THE MEMORY OF MY FATHER,
WHO TAUGHT ME HOW TO BE A MAN

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Imad A. Al-Sabbagh

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CHAPTER I

INTRODUCTION TO THE STUDY

People's need for information is increasing as life's complexity increases. In today's modern society, we are facing a continuous series of problems that require us to make an infinite number of decisions. To make these decisions as intelligently as possible, we need to understand the nature of each problem and how to solve it. Our experience tells us that this understanding is not to be reached without the availability of information.

Many studies have been conducted and theories have been presented to understand how to acquire information, the behavior of information, and how to control the flow of information.

The disciplines in which these studies and theories have been performed are numerous. However, it seems that many people are agreed that information science is the result of merging these disciplines.[1]

Unlike other interdisciplinary fields such as

biochemistry and biostatistics, information science may be considered as a unique discipline in which many of its scientists have backgrounds other than in information science. In other interdisciplinary fields the backgrounds of their scientists and contributors are easy to identify since they belong to one of the two or three original disciplines from which the interdisciplinary field draws. For example, in the case of biostatistics, the biostatistician may be either a biologist or a statistician; rarely would he be a chemist or an engineer.

The case of information science is quite different from these other interdisciplinary fields because people from almost any discipline may contribute to information science and may call themselves information scientists. This wide range of backgrounds has been a major factor in the disagreement between information scientists about what information science really is.

Statement of the Problem

Since 1959, when the term information science was introduced for the first time, there have been numerous studies to define information science and to determine its

nature and structure.[2] However, neither a generally agreed upon definition nor an acceptable structure of the discipline has yet been established.

One of the first attempts to explain the structure of information science took place in the early 1960's when Robert Taylor (1963) pointed out that information science in its theoretical aspects "cuts across such sciences as mathematics, logic, psychology, neurophysiology, and linguistics."[3] At the operational level, Taylor believes that information science "cuts across such technologies as electrical engineering, computer technology, management science, librarianship, and operations research."[4]

The interdisciplinarity of information science seems to be the one point that the majority of information scientists generally agree upon. Borko (1968) described information science as an "interdisciplinary field."[5] Since that time, interdisciplinarity has became a well-established characteristic of information science. Yet, this interdisciplinarity, the structure of the field, and the changes in the structure still have not been thoroughly examined.

The lack of a clear explanation of the inter-disciplinarity of information science and the changes in

this interdisciplinarity combined with the rapid evolution of information science and its literature caused great confusion and disorganization, even until today.[6]

The disorganization of information science can be recognized in the following:

1. There is no generally agreed upon definition for information science and its related concepts.

2. The structure of information science and the changes of this structure over time are not well established and explained.

3. "Information science education has been seriously hampered because of the lack of clarification and action in a number of problem areas."[7]

The absence of a clearly defined structure in the field of information science, has caused a lack of clear academic affiliation, degrees, and jurisdiction.

This study attempts to examine the Journal of the American Society for Information Science, (JASIS) to identify the major disciplines that have contributed to the literature of information science from 1970 through 1985 and to identify and trace the changes that took place in these contributions and disciplines during this period.

Objectives of the Study

This study has two basic objectives:

1. To describe the interdisciplinarity of information science on the basis of the reference patterns in the Journal of the American Society for Information Science (JASIS) from the first issue that carried the current title (January, 1970) through the last issue of 1985.

2. To identify the changes in the interdisciplinarity of the field based on the changes in the sources of the references in the articles of the Journal of the American Society for Information Science during the study period.

Significance of the Study

Most recently, information science has witnessed a rapid evolution that led to the creation of a relatively large number of educational programs to prepare information scientists and specialists to handle the fast growing information science related technology, activities and functions. These educational programs are different in terms of objectives, requirements, academic affiliation, and the way their faculty members understand, define, and teach information science.

The significance of this study is expected in the argument that the identification of disciplines that

contribute to information science and the recognition of the changes in these disciplines can lead to a better understanding of the previous, current, and probably the future structure and interdisciplinarity of information science. This understanding may provide some data, which is important for the design and establishment of inform-science educational programs, as well as to relate these programs to the most suitable academic units within departments, colleges, and universities.

The findings of this study may be considered as a contribution in an attempt to help information science to prosper and develop its own structure and theoretical principles.

Research Questions

The following research questions are to be answered by this study:

1. What are the disciplines that contributed to information science between 1970 and 1985?

2. How did the contributions of different disciplines to information science change between 1970 through 1985?

3. Which disciplines were the major contributors to the information science literature in the periods 1970-1974, 1975-1979, and 1980-1985?

Assumptions

The following assumptions are made in this study:

1. Information science is an interdisciplinary field of knowledge. It has strong relationships with many disciplines such as computer science, linguistics, psychology, mathematics, statistics, library science, management, chemistry, logic, etc.

2. The literature of the Journal of the American Society for Information Science (JASIS) is representative of the literature of information science. The justification for this assumption will be presented in Chapter Three.

3. References listed in JASIS articles represent materials that were used or consulted by the authors of JASIS articles. This led us to assume that the references of information science articles published in JASIS reflect the degree of interdisciplinarity of information science.

4. The change in the sources of references in information science articles in JASIS from 1970 to 1985 reflects the changes in the interdisciplinarity of information science in approximately the same period.

5. Dewey Decimal Classification (DDC) is an adequate classification system to serve as a method of classifying the subjects of citations which are examined in this study. However, this classification system is older than some of the disciplines such as computer science, that are major contributors to information science. Any modification of DDC to be implemented by this study are stated clearly.

Limitations

As indicated in the statement of the problem, the

basic aim of this study is to explore the inter-disciplinarity of information science based on the literature of JASIS, from 1970 through 1985. The aim of the current study is limited to achieve this goal only. Other problems of information science such as the definitions of the term "information science" or any related terms, the theories and laws of information science, and so on are beyond the scope and the concern of this study. It is therefore limited by the degree to which JASIS reflects the nature and structure of the discipline.

Definitions

The following definitions are selected to be used in this study:

Bibliometrics: "the application of mathematics and statistical methods to books and other media of communication."[8]

Citation: "the acknowledgment that one document receives from another."[9]

Citation analysis: "an activity involving analysis of the citation or reference which forms a part of the primary scientific communication."[10]

Data: "language, mathematical, or other symbolic surrogates which are generally agreed upon to represent people, objects, events, and concepts."[11]

Dewey Decimal Classification (DDC): "an arrangement of disciplines, or fields of study, with specific subjects collected under each and repeated as required ... The system begins by arranging knowledge as represented by library materials within ten "classes" identified by 0, 1,... 9,.... To each of classes 1-9 is assigned a major discipline or group of related disciplines... The notation used to designate each class consists of 100 three-digit numbers.... Each class is separated into ten "sections,".... The notation permits further subdivision to any degree desired, with the addition, following any three-digit number from 000 to 999, of a decimal point and as many more digits as may be required."[12]

Documentation: "The art comprised of (a) document reproduction, (b) document distribution, and (c) document utilization."[13]

Half-life: "the time during which one half of all the currently active literature was published."[14]

Information: "The result of modeling, formatting, organizing, or converting data in a way that increases the level of knowledge for its recipient."[15]

Information retrieval: "The process of recovering specific information from stored data."[16]

Information science: "The science that investigates the properties and behavior of information, the forces governing the flow of information, and the means of processing information for optimum accessibility and usability. The processes include the origination, dissemination, collection, organization, storage, retrieval, interpretation, and use of information. The field is derived from or related to mathematics, logic, linguistics, psychology, computer technology, operations research, the graphic arts, communications, library science, management, and some other fields."[17]

Information Systems: "Environments composed of people, equipment, and procedures organized to achieve specific information objectives."[18]

Interdisciplinary: "Combining or involving two or more academic disciplines or fields of study."[19]

Journal: "A periodical or a magazine, especially one published for a learned society or profession."[20]

Knowledge: "acquaintance with facts, truths, or principles, as from study or investigation."[21]

Librarianship: "is that branch of learning which has to do with the recognition, collection, organization, preservation and utilization of graphic and printed records."[22]

Nature: "The particular combination of qualities belonging to a person, animal, thing, or class by birth, origin, or constitution."[23]

Reference: "A set of bibliographic elements that refers to a work and is complete enough to provide unique identification of that work for a particular bibliographic function."[24]

Structure: "the manner in which the elements of anything are organized or interrelated."[25]

Other terms will be defined and explained as they occur in the study.

CHAPTER II

REVIEW OF RELATED LITERATURE

The literature reviewed for this study was divided into two parts. In the first part, the major studies that have investigated the origin, the interdisciplinarity, the development, the structure and the evolution of information science have been reviewed.

In the second part, the bibliometric studies that have investigated some aspects of information science, studies dealing with JASIS, some citation analysis studies and studies that have investigated the interdisciplinarity of other fields have been reviewed.

1. General Studies in Information Science

With the exception of a few studies, the interdisciplinarity and the structure of information science have not been the major foci of research in the field.

Most of information science literature, especially in

the early sixties, dealt with either the application aspects of the discipline or with the theoretical aspects such as the definition of information science and its related terms or the relationships of information science with other disciplines such as library science, linguistics, etc. The theories, structure, basic principles, and laws have not been investigated comprehensively.

This part of the review covers both studies which directly or indirectly deal with the structure or interdisciplinarity of information science and the major studies which investigate the theoretical aspects of the field in general.

Shera and Cleveland (1977) have indicated that Shannon and Weaver's 1949 Mathematical Theory of Communication is a logical place to start to search the theoretical aspects of information science.[26]

As an engineer at the Bell Telephone Laboratories, Claude Shannon needed to know precisely how much information is transmitted over communications channels in order to determine the channels' efficiency. To do so, Shannon found it necessary to quantify the concept of information and that is what he did in 1949 when with

Weaver developed the "mathematical theory of communication."[27]

Shannon and Weaver did not pay any attention to the meaning, the production and the transfer of knowledge; instead, their basic concern was with quantification aspects of communication systems. Shannon developed a communication system model that consists of five parts: information source, transmitter, noise source, receiver, and destination. In this model, information transfers from the information source to the destination through what Shannon called an information channel. The capacity of this channel was expressed in a mathematical formula, like all the other relationships and operations of the system.

Information scientists attempted to use Shannon's theory in hope that it would help them to gain better understanding of what information science is based upon. But, unfortunately, as Kochen (1974) indicated; this formula was not able to unlock the secret doors of information science because, according to Kochen, information theory is quite distinct from a mathematical speciality.[28]

Shannon's theory was one of the first attempts to discuss information transfer theoretically in mathematical

terms and may be considered to be a significant contribution to the development of information theory and of information science.

The term "information science" was used first time in 1959 during the "International Conference on Scientific Information" held in Washington, D.C.[29] However, no attempt to define the term "Information Science" was made during that conference.

In 1961 and 1962 attempts to explore the field of information science were made at the two conferences held at Georgia Institute of Technology in October 12-13, 1961 and April 12-13, 1962.[30]

The basic purpose of the conferences was to study the feasibility of offering training programs at Georgia Tech or other institutions to solve the problem of the manpower shortage in the information area and to exchange ideas to find the best approach to reach the goal of preparing science information specialists.

The conferences did not deal with the structure of information science. However, some basic ideas for the needs of information science educational programs were presented.

The other important product resulting from these two

conferences was the definition of "information science", which is one of the first definitions found in the literature.

The conferences defined information science as:

> The science that investigates the properties and behavior of information, the forces governing the flow of information, and the means of processing information for optimum accessibility and usability. The processes include the origination, dissemination, collection, organization, storage, retrieval, interpretation, and use of information. The field is derived from or related to mathematics, logic, linguistics, psychology, computer technology, operations research, the graphic arts, communications, library science, management, and some other fields.[31]

In discussing the procedures of these meetings, Robert Taylor (1966) stated:

> it is significant that the meetings were initiated by an institution without a library school, illustrating the unfortunate fact that innovation, even educational innovation, appears to come from outside the library schools.[32]

Robert Taylor (1963) in a previous article entitled "The Information Sciences", had indicated that:

> at the theoretical level information sciences deals with the study of the elements of the communication process such as information systems and human beings....it cuts across such sciences as mathematics, logic, psychology, neurophysiology, and linguistics.[33]

He stated that, at the operational level, information sciences, as a field, is concerned with the development of

information retrieval systems. Based on this fact, information science, in the operational aspects, "cuts across such technologies as electrical engineering, computer technology, management science, librarianship, and operations research."[34]

Borko and Doyle (1964) stated that information retrieval began to change from an area that deals with equipment orientation to become a higher level, more abstract field.[35] They believed that a new inter-disciplinary field was emerging which is "a true inter-disciplinary science involving the efforts of librarians, logicians, linguists, engineers, mathematicians, and behavioral scientists."[36]

Robert Taylor (1966) in the first volume of the Annual Review of Information Science and Technology reviewed studies focusing on the definition of information science and studies covering educational programs in information science and recommended that:

> 1. A formal attempt, possibly by the American Documentation Institute in collaboration with educational institutions and other organizations, must be made to describe the pedagogical framework of the subject....
>
> 2. Manpower studies must be continued to provide a better picture of what we are educating for....

> 3. From an operational standpoint, the spectrum from services to basic research must be described to isolate those portions that require fundamental development and financial support....[37]

Finally, Taylor believed the climate for the development of the field was becoming more favorable because similarities were beginning to be emphasized more than differences.

Weisman (1967) presented a paper in the fourth annual meeting of the American Documentation Institute, in which he indicated that information science is the one component of communication that deals with the production and management of recorded knowledge.[38] As a scientific discipline, information science "is relatively new. It was born out of the technology that produced data and information processing equipment."[39]

The basic concern of information science, according to Weisman, is what information is; how and where to find it; how to control its behavior; and how to use it. The major point Weisman attempted to highlight was the origin of information science. According to him, communication sciences are the origin of information science.

The interdisciplinarity of information science was the major concern of Gorn (1967) in his article "The

Computer and Information Sciences and the Community of Disciplines."[40] In this article, Gorn does not agree with other scientists, who investigated the emergence of information science. He believed that information science is not an interdisciplinary field but a discipline by itself. Gorn stated that information science is like any other discipline, growing in the same way an organism does.

Hoshovsky and Massey (1968) presented a paper at the fifth annual meeting of the American Society for Information Science (the name of the American Documentation Institute had been changed into the American Society for Information Science in early 1968) which defined information science as:

> that body of knowledge, consisting of descriptions, theories, and techniques, which provides understanding of the means through which society's information needs are met and which provides understanding required to improve capabilities to define and meet such needs.[41]

Hoshovsky and Massey argued that there are three basic tasks of information science:

> 1. To define a technique (methodology) to allow us to identify information requirements.
>
> 2. To provide a theory dealing with person-to-person information processes.

3. To come up with new and better means of defining needs for new knowledge.

Borko (1968), in a short paper entitled "Information Science: What is it?"[42] presented two comprehensive definitions for the discipline of information science.

Borko, in this paper, used the term "interdisciplinary" to characterize information science. He distinguished between information science and documentation in a period during which most people could not find a real difference between the two terms. Unfortunately, many people still are unable to distinguish between information science and documentation. Borko stated almost twenty years ago that "Documentation is one of many applied components of information science."[43]

Kitagawa (1968) in his article "Information Science and its Connection with Statistics"[44] stated that:

> by information science, we mean a newly organized branch of science....it is presently drafting a form of blueprint of its own future development ... constituents range over a vast ensemble of individual sciences, and it ... is an amalgamated science whose constituent branches have their respective scientific principles.[45]

Kitagawa indicated that there are five subdivisions which may be considered to be the components of the structure of information science. These subdivisions are:

1. Physical information phenomena.

2. Theoretical formulation of information phenomena, which includes: logic, theory of linguistics, statistical theory, mathematical programming, theory of information networks, information theory, etc.

3. Information system analysis.

4. Information phenomena in biological existence, which includes: neurophysiology, sensory information processing, etc.

5. Artificial realization of information phenomena, which consists of: information circuits, recognition apparati, language apparati, education apparati, etc.

Kitagawa added that information science is very strongly connected to statistics, behavioral sciences, cybernetics, documentation, mathematics, library science and bionics.

Hayes (1968) presented a paper at the conference of the Special Interest Group on Education in Information Science at the University of Pittsburgh in September 1968. Definitions for "information" and "information science" were developed in order to help rationalize various approaches that were being taken to provide education in information science.[46]

Information science was defined by Hayes as "the study of information-producing processes in any information system in which they may occur."[47]

Hayes believed that information science is concerned with and related to many sciences; some of them are: mathematics, logic, linguistics, computer science, engineering, operations research, management science, urban planning, military science, documentation, library science, psychology, economics, political science, organization theory, neurology, psychiatry, biology and microbiology, genetics, education, communication, etc.

Hayes' basic reason for discussing the relationships of information science was to design a curriculum for an academic program in information science.

Giuliano (1968), presented a paper at the same conference, in which he described the relationship between information science and librarianship as:

> a relationship between a science on the one hand and a profession on the other. It is like the relationship of medical science to practicing medicine ... just as a medical scientist needs not to be a medical practitioner, an information scientist needs not to be a librarian...and they are complementary and necessary one to another.[48]

A third important paper at the conference was presented by Anthony Debons and Klaus Otten[49]. They

argued that what is called information science is the crossing point of computer science, linguistics, information technology, communication theory, and cybernetics.

In a second paper one year later, Ottens and Debons (1970) attempted to outline the nature of information science.[50] They expected that this attempt would provide the basis for additional discussion about the field. They stated that "information, like energy, can be viewed as a fundamental phenomenon--the attributes of information are experienced in various forms (knowledge, news, etc.)."[51]

They indicated that information science is a meta-science and it should be called "metascience of information" or "informatology" because the discipline is not one field by itself, it is several disciplines dealing with the concept "information." They argued that the concept of metascience will help information by providing "a common language for scientists and technologists in divergent fields of specialization."[52]

In the case of information science three factors made the existence of what Otten and Debons called the "metascience of information" important. These factors are:

1. There is a need to provide a common basis upon which all information-oriented specialized sciences and technologies can be understood and studied.

2. A common framework and language must be established to serve technologists concerned with information in some form or another.

3. There is the need to build bridges between the abstract theories attempting theoretical explanations of the phenomena of information on the on side and between the (at present predominantly empirical) theories describing man's relationship to information phenomena on the other side.[53]

Finally, Otten and Debons indicated that metascience of informatology by itself is an independent science; however, it has some concert with other disciplines such as psychology, computer science, linguistics, engineering sciences, mathematics and library science.

In discussing the scientific aspects of information science, Yovits (1969) indicated that in order for information science "to be considered a true science similar to physics or chemistry, then it must have a set of concepts and analytical expressions which apply to the flow of information in a general way."[54] To develop this set of concepts, Yovits and colleagues developed an information system model called GIS (the Generalized Information System). This model consists of External Environment; Information Acquisition and Dissemination;

Decision Making; Execution and Transformation.[55]

In the GIS, data is acquired from the external environment by Information Acquisition and Dissemination component, then is processed into information to be used for decision making. The decision making is, in fact, the selection of a particular course(s) of action. This course of action is executed and action is taken. This action is observed or recorded as data to be acquired for further decision making.

In 1971, Belzer and his colleagues in the Curriculum Committee of the Special Interest Group/Education for Information Science (SIG-EIS) of the American Society for Information Science identified nine disciplines that contribute to information science. These disciplines were: Psychology, Behavioral Science, Linguistics, Statistics, Mathematics, Management Systems, Library Science, Computer Science, and Information and Communication Theory.[56] The identification of these disciplines came as one result of a study done by the Committee in the early 1970's that included eighty-five schools offering information science-related courses.

In an opinion paper for the Journal of the American Society for Information Science, Harmon (1971) interpreted

the development and the evolution of information science as a discipline in its wider framework.[57] He believed that information science is "one of a modern generation of communication or behavioral disciplines which emerged almost simultaneously around World War II."[58]

Many fundamental and basic issues related to information science are investigated in Harmon's paper. The first issue is the development of information science as a discipline. Harmon stated that documentation and information retrieval may be considered to be the origin of information science. The second issue discussed by Harmon is the relationships of information science to other disciplines. In this aspect, Harmon cites Kitawaga discussing the relationships of information science to other fields, which include statistics, mathematics, cybernetics, documentation, library science, behavioral sciences and other disciplines.[59]

The third issue discussed by Harmon is the future development of information science. Harmon predicted that:

> in the early 1970s information science will possibly achieve completeness as a disciplinary system. By 1990, it should achieve a relative state of maturity; specialization within its ranks could become intense. But new fusions and fissions, with attendant name changes, could occur within the next two decades.[60]

The basic goal of Wellisch's paper (1972) was to answer two questions people were asking at that time: "Is there an information science? and is it indeed a science?"[61]

Wellisch, like many others, thought that documentation and information retrieval are the basis from which information science was developed. He indicated that the first usage of the term "information science" was used in 1959 during the International Conference on Scientific Information. The term information science used to mean "the study of recorded knowledge and its transfer in the widest sense."[62]

Wellisch discussed many issues in the foundation and development of information science including: the definitions of information science; whether it is "information science" or "information sciences", computer science vs. information science, and definitions of information and informatics. He stated that:

> several attempts have been made by various writers to propose or suggest alternative names for IS, partly because they had doubts whether the field really merited the name of a "science", but mostly because they thought that if IS indeed was a science, then it should also have a distinctive name of its own, as in the case of the established branches of science.[63]

Wellisch believes that the term "informatics," which was developed by the Russians, Mikhailov, Chernyi, and Gilyarevskii in 1967 is the most successful and beneficial term for three basic reasons:

> a. Since it can be shown that IS has at present neither a well-defined central topic nor several other attributes of a true science, a neutral name would arouse much less controversy about the scientific nature of the field....
>
> b. The name informatics satisfies several criteria for the designation of a new discipline:
>
> (i) it consists of one word only.
>
> (ii) it implies the central topic of the discipline.
>
> (iii) it cannot be confused with any other name.
>
> (iv) it will be readily understood, because the term is familiar to everybody.
>
> (v) other terms can be derived from it, such as informatician for a person who is engaged in activities in this field....
>
> c. It has already been used in several English language publications ... and will probably be used increasingly in international practice.[64]

Two years before Wellisch, Anthony Debons and Klause Otten have suggested that the term "Informatology" may substitute the term "Information Science", their reasons were similar to Wellisch's.[65]

Eugene Rathswohl (1973), in a doctoral dissertation, discusses the topic of developing a critical science of information.[66] Rathswohl indicates that his basic concern is "to conceptualize the kinds of tasks such a critical science of information must perform."[67] Two tasks are proposed by Rathswohl. The first is the development of a theory concerning the characteristics of information systems. The second task is "to apply such a theory in the critique of present and proposed information system design strategy".[68]

Rathswohl adopts the term "informatology" as an alternative name for information science.

He devotes one chapter of his dissertation to discussing each of the following issues:

1. the interests of information science;
2. the social need for information;
3. the implementation of information systems;
4. the information systems models as conceptual resources available to information sciences;
5. the critique of the models used to design information systems; and
6. the selection of one model from those discussed in the previous chapters.

In summary, Rathswohl has conceptualized informatology as "a critical metascience with the practical

intent of facilitating the information system design process."[69]

In discussing the nature of information, Thomas Martin in his doctoral dissertation (1974) stated that:

> an informational phenomenon can be thought of as nonphysical but carried by physical events... the information sciences are likely to extend man's control over informational phenomena not by the discovery of fundamental laws but from the reshaping of his physical/informational environment.[70]

Manfred Kochen (1974) found that many studies had been conducted to investigate the nature of information, but as of 1974 the search for a paradigm of an emergent information science was still very much of a challenge.[71]

Kochen attempted to present a few steps toward "shaping" the paradigm of an emergent information science.

He presented four views of information science from different points: information theory, computer sciences, behavioral sciences, and information science in what Kochen called "the narrow sense."[72] He believed that:

> information theory was at first felt to have potential for shedding light on the processing of information in living organisms, in human performance, in the growth of knowledge. It did influence and enrich psychology and some other disciplines. Then it matured and became an independent, respectable discipline. It drifted apart from what is now information science in the narrow sense.[73]

From the computer scientist's point of view, information science is a field of study concerned with the computer-human interaction and the human usages of computers.

Kochen believed that psychologists, linguists, economists, and other behavioral and social scientists contributed greatly to the foundations of information science in the last three decades in the human information processing and other behavioral aspects of information science.[74]

Information science, in the narrow sense, according to Kochen, began with both documentation and information retrieval.

Kochen concludes his study by indicating that "information science, both in the broad and in the narrow sense, has a central concern with the growth of knowledge, understanding, and wisdom."[75]

Two years later in another study, Kochen (1976) indicated that most behavioral sciences and information science are still in the development stage.[76] This makes it very likely that information science will be able to take from and give to behavioral sciences.

In a paper presented at the NATO conference in

Aberystwyth, Xavier Monasterio (1973) differentiated between two views of information.[77] He stated that we, in our daily lives, see "information in terms of meaningful reference and purposive action."[78]

The other view, according to Monasterio, was emerging in the current years, which "sees information in physical terms as a mathematically formalizable function."[79]

Wersig and Neveling (1975) indicate that information science has developed out of the needs of information retrieval and documentation.[80] They strongly argue that the discipline has not been developed out of another discipline of study like linguistics or psychology or from the marriage of two or more disciplines like biostatistics or biochemistry.

On the other hand, they state that many fields, such as linguistics, psychology, library science, computer science, philosophy, cybernetics, mathematics and others, have contributed to the creation and development of information science.[81]

Others agree with Wersig and Neveling that information science has grown out of practical needs, but these needs according to Farradane (1976) are "to know what has been done, the need to keep up to date; the need

to save time and money if something has already been done, or has proved ineffective."[82]

Brookes (1976) states that the major problem of information science is the development of the practical aspects of the field before its theory.[83] He questioned:

> whether the physical paradigm which solved the technical problems of the industrial revolution [Brookes believes that the industrial revolution suffered from the same problem of information revolution, that is the development of practical aspects - the steam pump -before the theoretical aspects -the theory of heat-engine] is the appropriate paradigm for tackling the basic problems of the information revolution into which we are now moving.[84]

Brookes argues that information theory has two aspects: one is physical/mathematical/statistical. The other aspect is more humanistic because information systems are used by humans.

Jeremy Clift (1976) agrees with Ronald Stamper, the senior lecturer in systems analysis at the London School of Economics, in saying:

> "work in information field is fragmented. Business studies, computer science, social studies and many other disciplines all have connections with, and should have an interest in, the development of information studies... [and]... there is need for far more discussion across discipline boundaries as part of a cross-fertilization of ideas, that could eventually form the basis of science of information."[85]

Even though the above statement is nearly ten years old, it seems valid even today if a close look is taken at the educational programs in the area of information science.

Clift indicates that the relevant knowledge for information science is available in many disciplines such as social psychology, anthropology, psycholinguistics, statistics, epistemology, logic, programming theory, communication, probability, experimental psychology, and other disciplines.

While Clift agrees with Stamper about the fact that the idea of a science of information is old, he indicates that the information science "proponents still find themselves out on an intellectual limb, though it's a growing limb."[86]

In a study presented at the Information Science Institute's Annual Conference held at St. Andrews, 18-20 June, 1976, Jason Farradane discusses the origins and the nature of entities and processes involved in information science.[87]

The most important point of the study was stated by Farradane as the following:

if, therefore, information work is to pass

> from the stage of being an art, whereby experienced individuals exercise detective faculties to find required data, or computer systems are proliferated without any basic understanding to the real structure of knowledge, and reach the stage of its being a true science -- an entirely new approach must be made.[88]

The definitions of information science and its related terms are addressed by Farradane in his study; however several definitions for the terms were presented.

Farradane points out that the field of information science is concerned with human intercommunication. However, information science, according to Farradane, is:

> barely as yet a branch of science. Perhaps because of undue haste, but also intellectual laziness, we have been expecting easy solutions, and we are still struggling with an art, a computer analyst's by-product, a sideline interest for other disciplines.[89]

He concludes his study by indicating that since there is an increasing need for better informed people, the need for a well established information science as a discipline and a field of study is increasing and becoming more urgent daily.

Nicholas Belkin (1977) agrees with Wersig and Neveling about their argument "that information science developed in response to the increasing social relevance of the problem of transmitting knowledge to those who need it."[90]

He points out that it is clear that information science is concerned with knowledge and that:

> information is the fundamental concept of the study of information science because information as a phenomenon is more important to the information system than the process (communication) within the system.[91]

He also believes that, in order for information science to be effective as a science, the "information is a concept which must be agreed upon, both in terms of its existence and in terms of what it might be."[92]

The problem of the thesis is stated as:

> the development of an operationally relevant concept of information for information science which would be applicable to the general context of information science and serve as a central concept or analogy about which the various activities of information science could be integrated especially in a theoretical sense.[93]

Belkin believes that the information science literature shows that there are no unifying principles or paradigms about which the whole field is organized (or if any such exist, they are not recognized as such), that there is no theory on which experimentation and practice can be based, and that there is, in fact, substantial disagreement about what constitutes information science.

This disagreement has led the discipline and its writers to investigate a variety of different disciplines

in order propose acceptable theories and definitions for information science and its concepts.

Belkin indicates that information science needs:

> a concept of information which is based on a relevant communication system, which takes cognizance of the effect of information with that effect, and which related some externally observable phenomenon to internal events in a predictable and generalizable way.[94]

Belkin proposes a recipient-controlled human communication system as a base for an information concept. The basic elements of Belkin's communication system are: generator; text; recipient; state of knowledge; and information. Based on this system, Belkin defines information as:

> the information associated with a text is the generator's modified (by purpose, intent and knowledge of the recipient's state of knowledge) conceptual structure which underlies the surface structure of the text.[95]

Jesse Shera and Donald Cleveland (1977) attempted to reconstruct the history of information science.[96] Their approach was to select and discuss studies they--Shera and Cleveland--thought had contributed to the foundations of information science.

Many basic issues in the foundations of information science were presented and discussed. These issues

included the origins and definitions of documentation, the history of the American Documentation Institute, the information science era, the transformation of documentation into information science, the theoretical foundations of information science and the problems associated with the definition of information science.

Shera and Cleveland believed that the old bibliographic studies and documentation (as a discipline) developed to become information science.

After they discussed the establishment of the American Documentation Institution, they argued that some of the members of the Institute had interests outside the objectives of the Institute, which was specifically microphotography in libraries. One of the member's interest was the evolution of so-called scientific information.

Shera and Cleveland considered the "International Conference on Scientific Information" held in Washington D.C. in 1958 to be the "event which most dramatized the transforming of documentation into information science."[97]

The development of new information technologies coupled with an increased interest of the public and governments in the problems of information science played,

according to Shera and Cleveland, a fundamental role in providing a suitable climate for the development of information science in the 1960s.

Shera and Cleveland described the Shannon and Weaver information theory as the point at which to start to discuss the theoretical foundations of information science.

The study, in general, presented the Shera and Cleveland point of view of the origins of information science. They made it clear that they believed that documentation had evolved into information science in the early 1960s. Many information scientists share this idea with Shera and Cleveland. Others, as shown in this study and as will be discussed further, believe that documentation was one of the foundations upon which information science was based but not the only one.

A study by Zunde and Gehl (1979) of the Georgia Institute of Technology investigates:

> the foundations of information science as an empirical discipline and [discusses] research efforts that are attempting to strengthen and to expand the scientific foundations upon which all other work in this area is ultimately based.[98]

The study of the nature of information was identified by Zunde and Gehl to be the central problem in information

science. They indicated that:

> information science as an empirical discipline is not concerned with what information is in an ontological or metaphysical sense. Problems of this kind lie in the domain of philosophy, not science. The subject of concern to information science is the phenomena through which the nature of information is revealed and embodied.[99]

They believe that information science theories are underdeveloped.

They end their study by presenting the following conclusions:

> 1. Many laws of information science have been proposed, but most are still hypotheses that need to be verified and validated under more diverse experimental conditions and on a more comprehensive collection of empirical data;
>
> 2. In many of the proposed laws or hypotheses, constructs used in the theory are not the same as their operationally defined counterparts;
>
> 3. Many constructs that appear in the proposed laws or hypotheses have little significance for information science;
>
> 4. More general systems (methods) of information measurements, particularly more comprehensive measures of information in all its diversity, need to be developed; and
>
> 5. No sufficiently general principles have been discovered, and theories of information science are in the early stage of development. Most of the proposed laws and hypotheses have limited applicability.[100]

Belzer (1979) aimed to show that some of the foundations for information science have already existed. He indicated that:

> a theory or organization, coding theory representation of information and units of measures as derived from information theory and data structures provide foundations for information science.[101]

Belzer believes that the basic fields which provide foundations for information science are: mathematics and linguistics.

Sager (1979) compares the structure of information science with the structure of language.[102] She found that the two structures are not identical; however, they are strongly related.

In the first of a two part study directed toward identification and discussion of the problems associated with the education of information science, Saracevic (1979) provides an excellent discussion about the development and structure of information science.[103]

On the matter of definition of information science, Saracevic provides four definitions which deal with the meaning of information science. He indicates that three directions emerged in information science which could be recognized through the definitions of the discipline:

> (i) professional (applied, practical) - concerned with information systems, services and networks, and information users and uses, as well.
>
> (ii) technological - concerned with application of information technology to handling of information.
>
> (iii) scientific (basic) - concerned with theories and experimentation dealing with communication and information and with information systems and processes within systems.[104]

Saracevic adds:

> what emerged in the 1950's and 1960's as information science grew out of the problems and concerns associated with communication of public knowledge in particular. In the broader sense these problems lead to concerns with communication as a general process; in a narrower sense they lead to concerns with communication of recorded public knowledge.[105]

Saracevic adopts the Shannon/Weaver communication model, which defines levels of problems in communication, to define levels of problems in information science.[106] These levels are: technical, semantic, and effectiveness. He believes that information theory deals with the technical problems while the field of linguistics deals with the semantic problems, "information science is concerned with the effectiveness or behavioral problems in communication of public knowledge."[107] He adds that

"information science has emerged in the context of the newer communication fields and not as an expression and metamorphosis of librarianship or documentation."[108]

Saracevic believes that the term "information science" slipped into usage in the early 1960s. He indicates that the concern of information science in the 1960s was about information retrieval systems and their functions. In the 1970s, this concern shifted toward a wider area of research that deals with information systems in general rather than information retrieval systems only. Also, the general foundations of information science began to receive more attention in the 1970's.

Poole, in a 1985 book based on his 1979 dissertation at Rutgers, attempted to:

> find a way to take a set of studies reported in the literature and to synthesize their findings in such a manner as to reveal which the underlying principles were that would explain the behavior of scientists and engineers working in formal information systems settings.[109]

Poole believes that, on the one hand, the absence of an agreed upon information science theory threatenes the intellectual foundations of the discipline. On the other hand, Poole found that theoretical research in information science is non-existent which has caused the field to suffer from unclear theoretical principles.

Poole concludes his study by indicating that:

> for the greater part, information scientists, at least within the sample chosen for the research, have concerned themselves with many aspects of information, but little has been done with the use of information insofar as how the commodity was actually put to use. The label "information use" study is an apparent misnomer.[110]

In another Ph.D. dissertation, Andrea Burgard of Maryland examines the Annual Review of Information Science and Technology for the period 1966-1975 to trace the development of the intellectual structure of information science.[111]

For Burgard, the intellectual structure of information science is composed of the concepts which form the territory of the field and the organization of these concepts into subfields and research areas.

In her Ph.D. dissertation, Linda An of Rutgers attempts to study the nature and development of information science from a linguistic approach by hypothesizing that information science vocabulary has behaved in the following manner:

1. Its pattern of growth and change should be like that of an organism.

2. Its development should become more stabilized over time.

3. Its literary style should become more scientific over time.

4. Its statistical structure should become more like the "general structure" of all languages over time.

5. Its lexical composition should become more distinct from "common English" over time.

6. The Information Science community should become more coherent, by having members sharing more of the identical word-pairs over time.[112]

To investigate her hypotheses, she studied the information science vocabulary, composed of the title words of the literature that was abstracted in Information Science Abstracts for five years: 1951, 1958, 1966, 1970, and 1974.

Her findings support four of her six hypotheses. The findings could not support the third hypothesis (information science's literary style should become more scientific over time). An found that "the style of information science vocabulary has always been in-between the scientific texts and the nonscientific text. And it has not been sufficiently proved to be more scientific over time."[113] Also, the sixth hypothesis (the development of word-pairs) was not supported by the findings.

In discussing the state of information science in Japan, Toyama, Nakayama, and Oikawa (1980) state that because of the interdisciplinary nature of information science, the definition and development of the discipline are the task of the future.[114] They also indicate that "researchers in this field [information science] are currently working in cooperation with those from a wide spectrum of conventional divisions of science."[115] The reason behind this cooperation is the interdisciplinarity of information science.

Chambaud and Delpech (1980) agree with Toyama and his colleagues about the interdisciplinarity of information science when they state that:

> in fact the information sciences appear to be at the meeting point of many other sciences like computer science, linguistics, electronics, telecommunication, mathematics, psychology, sociology, economics, etc.[116]

They believe that one of the major concerns in information science at that time was to define the discipline.

In a long four part study, Brookes (1980) identifies and discusses different aspects of information science. In the first part of the study which is entitled "Philosophical Aspects", Brookes indicates that

"theoretical information science hardly yet exists ... so information science floats in a philosophical limbo. It has no theoretical foundations."[117]

The second and third parts of the study are concerned with the quantitative aspects of information science. In the second part, Brookes presents and discusses what he called "classes of things and the challenge of human individuality."[118] After a long introduction about how numbers were developed by Sumerians and then by Arabs, Brookes discusses both the frequency-rank technique and the frequency statistics techniques. In the third part, Brookes presented what he called "objective maps and subjective landscapes."[119] In this part Brookes attempts to compare the metrical characteristics of the so-called "information space" with metrical characteristics of physical space. He used an abstract model to "show that information space is like that of landscapes and skyscrapers."[120] The Shannon communication theory is presented and discussed in this part.

In the same part, Brookes explaines how Sir Karl Popper distinguishes between three worlds: the first, the physical world in which we live. The second is the world of "our individual mental states."[121] Finally, the

third world which is "the new man-made world of objective knowledge yet to be organized for effective use."[122]

Brookes believes that the mental spaces of Worlds I and II were different from the familiar space of the physical world in which our bodies live and move and that, in World II, each of us creates his own unique mental space and furnishes it with our own mental images.

In the fourth and last part of the study, Brookes discusses what he calles "the changing paradigm" of information science.[123] Bradford's law and its social relevance discussed in this part.

Brookes concludes his study by indicating that:

> there is a very important role for a science of information, a role as yet unclaimed by any other discipline, and which is a logical and natural extension of the interests and activities of those who currently claim to be information scientists...the physical event occurs in World I and the cognitive observation of it takes place simultaneously in the observer's subjective World II.[124]

Farradane (1980) presents and discusses his thoughts about the scope of information science.[125] His basic goal is "to show the problems involved and the areas of research needed to develop the subject as a science."[126]

Farradane points out that it is time to present a model of the scope of information science; however, the

presenting of a model of this scope is not possible because, according to Farradane, "we do not yet have enough reliable data to make a model; a model should be predictive, yielding quantitative results which one can test by experimentation."[127]

Farradane defines information as "a physical surrogate of knowledge (e.g. language) used for communications."[128] He defines knowledge as:

> a memorable record of a process in the brain, something available only in the mind; the production of consciousness in the mind is at present quite unexplained.[129]

Farradane believes that information science is a part of the field of communication, and it is a cognitive science. He states that:

> we know a great deal in practice about the handling of information in storage and retrieval systems but the connections with knowledge are equally important for the development of a science of "information", which is what information science should be.[130]

Farradane presents several issues in information science that need additional study and investigation. These issues include: the transformations and distortions of information such as editing, printing, indexing, coding, etc.; the issues of standardization and definitions of information science which have not been

agreed upon yet; and the process "that by which a person discovers a gap in his knowledge, or an incomplete extension to his knowledge structure, or some other inconsistency."[131]

Hollangel (1980) discusses some of the problems existing in information science based on his experience with similar problems existing in psychology.[132]

Hollangel indicates that both information science and psychology have the problem of defining their terminology. He suggests that information science is still a young science and, because of that, it "has some trouble with the definitions of its subject matter and of itself, particularly in the present age of communication."[133]

Hollangel believes that the problem of definition of information science is not as serious as many people think. Because information science is a behavioral science which is concerned with well-observed phenomena that already has been described in natural language. This means that there is no need to define the field's terms rigorously first, since we know what we are talking about when we discuss information science.[134]

Hollangel concludes his study by saying:

> information science, in spite of the connotations which are evoked by the word information, should concern itself more

> with the states of incomplete knowledge, uncertainty, and lack of information, than with defining information.[135]

A doctoral dissertation to explore some aspects of library science and information science was done at Indiana University by Alvin Schrader in 1983.[136]

In this study, Schrader applies an analysis technique to study the existing definitions of library and information science.[137] He thinks that:

> information science and its antecedents have been hailed, variously, as more innovative, as more intellectual, as more scientific, and as more theoretical, than library science.[138]

The two basic objectives of Schrader's study are:

> to make available in one document every identifiable definition [of library science and information science] in the published literature, and to assist in promoting and in achieving greater precision and clarity of domain conceptualization.[139]

Schrader used the SIGGS theory model to provide a logical base for proceeding in his inquiry.

SIGGS was introduced in 1963 by Steiner, Maccia, and Maccia. SIGGS stands for: Set theory (S); Information theory (I); Graph theory (G); and General system theory (GS).

To analyze the definitions in library science and

information science, Schrader posits "a logical and conceptual analytic approach to the definition of a domain of library and information science."[140]

In the information science area, Schrader analyzed 695 definitions and comes to the conclusion that "the conceptualizations of information science are inadequate."[141]

Finally, Schrader states that "it is obvious that the universe of discourse of library and information science is not already neatly defined and awaiting discovery."[142]

Zunde (1984) believes that Lotka's Law and Zipf's Law could be accepted as theories in information science.[143]

He believes that the problem with these laws appears in the fact that none of these laws has an independent testability and they do not present any new knowledge.

Finally, he states that theories which provide empirical principles are desperately needed in information science.[144]

Keren (1984) questions how much information scientists contributed to the general body of knowledge in the field of information science.[145] He indicates that most of information science research is not useful to information practitioners because it deals with less

practical issues in information science[148].

Herner (1984) attempts to trace the history of information science from its existence to the 1980's.[147] He suggests that one of the first attempts to bring the inadvertent founders of information science together was Vannevar Bush's article "As We May Think", which was published in the Atlantic Monthly in 1945.[148]

Herner bases this suggestion on two reasons; first because the article "called attention to the important role of information in the massive research and development effort mobilized in support of World War II."[149] The second reason is that the article declared the necessity for information in the continuing of research and development (R&D) environment.

Most of the materials presented by Herner were personal view of what he thinks information science is, which may not be acceptable to other researchers. Even his historical discussion, which is the only reason to include this paper in this review, does not cover the major studies and events of the development of information science which were covered by many other studies.

Herner himself knew that he was not able to cover most of the developments of information science so in his

conclusion he indicated that:

> this short attempt at a historical summary of a field as complex and amorphous as information science is perhaps presumptuous. There is no question that in my coverage of the main writings of the field I have left out much more than I have included. The same can be said of pivotal events and developments.[150]

Boyce and Kraft (1985) reviewed literature published after 1979 which dealt with the foundations, principles, and theories of information science.[151]

They indicate that they "did not expect to find many theories within the bounds of information science."[152] That is what happened; they were not able to find any information science theory. But they found that information science:

> has been more concerned with the facilitation of communication processes than with their explanation. Any explanation that does occur comes primarily from the application of theories and models developed elsewhere for other purposes.[153]

In their conclusions, Boyce and Kraft indicate that information scientists:

> make good use of the tools of other disciplines, yet [they] have been much less successful in explaining what ... [they] know, in an integrated and coherent manner"[154].

2. Bibliometric Studies in Information Science, Citation Analysis, Studies about JASIS, and the Interdisciplinarity Studies.

2.1. Bibliometric Studies in Information Science

Three bibliometric studies were found to deal with the area of the interdisciplinary structure of information science and the subject literature of the field.

The first study is a doctoral dissertation done at Case Western Reserve University by Elmer Harman in 1970.[155]

A result of analyzing developmental chronologies of important breakthroughs in physics and mathematics was the development of an equation that Harman applies to the chronologies drawn from information science and other disciplines.

Harmon's findings rejected the arguments that information science was the result of the evolution of documentation and information retrieval only. It was found that:

> Information science appears to have emerged not only as an expression and metamorphosis of documentation and information retrieval; it directly or indirectly incorporated or paralleled several prevailing objectives and

> concepts of the communication and behavioral sciences and other contributory disciplines. The communication and behavioral sciences emerged with documentation and from the outset apparently shared many of its problems. The formative patterns of documentation resembles that of other disciplinary systems. In the early 1970's information science will possibly be completed as a disciplinary system. By 1990, it should have achieved a relative state of maturity, specialization within its ranks could become more pronounced.[156]

The second study was published in 1973. In it, Joseph Donohue uses the subject literature of information science to conduct a bibliometric study of the field.[157] To perform this study, three bibliometric techniques were integrated: Bradford's Law,[158] epidemic analysis,[159] and citation and bibliographic coupling.

One result of the study is the development of a list of journals Donohue calles "representative of information science". Ten years later, Afsharpanah called this list "a strange list."[160] Lancaster (1974) also criticized the results of the study after he heavily criticized the sampling technique and the methodology.[161]

One of the most comprehensive studies in the area of using bibliometric techniques to study the structure of information science was done by Shahrokh Afsharpanah in his Ph.D. dissertation at Case Western Reserve University in 1983.[162]

The purpose of Afsharpanah's research is to:

> explore the subject relationships that an interdisciplinary field develops with other disciplines in order to solve and explain modes, laws, theories, and techniques.[183]

The general objective of the dissertation is:

> to explore the interdisciplinary structure of ...[information science] ... on the basis of the citations patterns of its subject literature.[184]

One of the specific objectives of the study is "to identify subjects that make up the core interdisciplinary structure of information science."[185]

To identify the relatedness of the contributory fields to information science, Afsharpanah uses a classification system developed by William Goffman of Case Western Reserve University in 1969, which was called "an indirect method of information retrieval."[186] In this technique it was made possible "to partition contributing disciplines into equivalent classes based on the number of attributes that each pair of disciplines have in common."[187]

Afsharpanah selected the first thirteen volumes of the Annual Review of Information Science and Technology (ARIST), 1966-1978, to collect data. His data were limited to the journal articles reviewed in 154 review

articles published in the thirteen volumes of ARIST. He reviewed a total number of 19,682 items from various forms of literature.

Afsharpanah applies this methodology to the subject literature of information science to explore the inter-disciplinary structure of the field. He uses two factors of relatedness: authors and subfields, to reach two objectives:

1. To study the interdisciplinary demands of information science.

2. To study the research interests and backgrounds of the authors in information science.

Two experiments were conducted by Afsharpanah in his study. In the first, he found forty-nine outside contributory subjects, he generated intercommunication classes by starting with threshold .50 and going down to thresholds .40, .30, .20 and .02. At the .50 threshold the outside subjects were distributed over thirty-nine classes. The number of classes decreased when the threshold went down. At .02 threshold all forty-nine outside subjects were absorbed into one class only. The second experiment was to study the impact of authors. The number of authors was found to be 447. Afsharpanah categorizes them in two categories:

A) those who had cited from the literature of the outside subjects; and

B) those who had not cited from the literature of the outside subjects.[168]

After that, authors in each category were recategorized in two group categories:

1. authors who were cited by others in the literature that was selected and,

2. authors who were not cited by others.

Afsharpanah applies the Chi square test to find out if the impacts of authors who cited from outside subjects and the authors who limited their citations to the literature of information science on the others in the field were significantly different.

In his conclusion, Afsharpanah presentes five basic findings:

> 1....individual subfields of information science, and the whole field in general, used more outside subjects and thus established stronger communication links among the subjects represented in matrix Ms [the matrix that constructed from conditional probabilities of relatedness among the forty-nine outside subjects]. These probabilities were determined by the number of citing information science subfield in common between each pair in the outside subjects. The values of these probabilities ranged from .05 to 1.00.
>
> [2]....individual authors of information science

> cited from the literature of fewer outside subjects, and thus, established weaker communications links among the subjects represented in matrix Ma [it is a matrix constructed from conditional probabilities of relatedness among the forty-nine outside subjects. These probabilities were obtained from the number of citing authors in common between each pair of subjects].
>
> [3]....there was a considerable diversity among the authors of information science in terms of their background studies and research interests.
>
> [4]....considering the number of citations made to the electronic data processing, computer systems, probabilities and applied mathematics, linguistics, and general management, ... it seems reasonable to accept these subjects as representative of the core interdisciplinary structure of information science.
>
> [5]....subjects of great demand to information science are of a highly specialized nature, and that each of these subjects is introduced into the field by a separate group of authors whose background studies and research interests can rarely be related to other subjects of high demand.[169]

Finally, one of the basic findings of Afsharpanah is:

> authors who use outside subjects in their articles have a greater impact on the field of information science, and receive more citations in the subject literature of information science than the authors who only cite from inside subjects.[170]

2.2. Citation Analysis Studies

It was widely held that the published literature of a discipline may be considered a good reflection of the state of the field. This belief has led many researchers to use citation analysis as a data collection technique for their studies. Small (1981) indicates that:

> one way of gaining insight into the state of a research field or discipline is to examine the publications produced by its practitioners ... by using the statistical techniques of citation analysis we hope to get a picture of how the field [information science] has developed, the main lines of research in the field, its principal foci of interest, and where the field appears to be going.[171]

What, then, is "citation analysis"? Lawani (1981) defines citation analysis as "counting and analyzing citations."[172]

In defining citation analysis, Linda Smith (1981) indicates that:

> in general, a citation implies a relationship between a part or the whole of the cited document and a part or the whole of the citing document. Citation analysis is the area of bibliometrics which deals with the study of these relationships.[173]

Gupta and Nagpal (1979) define citation analysis as "an activity involving analysis of the citation or

reference which forms a part of the primary scientific communication."[174]

Citation analysis may first have been used in a 1927 study by Gross and Gross who conducted a citation count of the references appended to the articles appearing in the 1926 issues of the Journal of the American Chemical Society.[175]

Linda Smith (1981) provides two reasons why citation analysis is becoming a popular research technique. These reasons are:

1. Citations are readily available.

2. Citations are unobtrusive measures, in that they do not require the cooperation of the respondent.[176]

Earle and Vickery (1969) measure the degree of the dependency of a field on the literature of other disciplines by using citation analysis.[177]

Bluma C. Peritz (1981) states that "citation analysis of the papers in a given discipline often reveals some relevant characteristic of its research activity."[178]

Small (1981) uses citation analysis to explore the internal structure of information science and its development.[179]

Belkin (1977) believes that bibliometric techniques

can be used to investigate the characteristics of a discipline, which may be considered to be clear indicators of the state of that particular discipline.[180]

Afsharpanah (1983) indicates that "Review articles represent the relevant literature of a field, and reflect its basic and up-to-date developments."[181] He addes that:

> subject literature can serve as a major source of data for analysis of subject relationships, and provide operational means for studying interdependency between disciplines.[182]

In research, one form of citation analysis or another has been used to highlight structures of different disciplines.

The few citation studies presented above are just a few of a huge number of citation studies performed in recent years. To cover them all, several volumes would be needed.

2.3. Studies about JASIS

In an article based on a master's thesis published in Nachrichten fur Dokumentation (NFD), Eisenhardt (1979) conductes a bibliometric study in which he attempts:

> to find out if there are significant differences in the citation habits and in the literature used by authors on information and documentation who write in the leading American and German professional journals.[183]

Eisenhardt chose one hundred articles randomly from JASIS and NFD for the period 1966-1975. By using a Chi-square test, the following results were indicated by him:

1. 63% of JASIS articles were written by one author 37% by more than one person. The figures for NFD are 83% and 17% respectively.

2. The average length of JASIS articles was 7.7 pages. For NFD, the average length of articles was 5.9 pages.

3. In JASIS the number of citations in the sample was found to be 1,334 citations. In NFD the number was 1,049.

4. 10% of JASIS articles found to have no citations. This percentage was 45% in NFD.

5. It was found that authors of JASIS articles cited themselves 82 times. NFD authors cited themselves 86 times, in that sample.

6. JASIS authors used only 27 citations (2%) from languages other than English (the language of JASIS). NFD authors used 301 citations (28.7%) from languages other than German (the language of NFD). Most of them (272) were in English.

7. 46.8% of JASIS citations were found to be journal articles, 26.5% monographs, and 26.7% semipublished literature. For NFD these figures were 42.8%, 23%, and 34.2% respectively.

8. For JASIS the average half-life of citations was 4.2 years. For NFD this average was 1.6 years.

> 9. It was found that JASIS periodicals citations came from 121 sources. NFD periodical citations came from 150 periodicals.
>
> 10. The major three journals that were cited by JASIS authors were JASIS itself, followed by Science, and Journal of Chemical Documentation. In NFD the three major journals were: NFD, JASIS, and Zeitschrift fur Bibliothekswesen und Bibliographie.

Meadow and Zaborowski (1979) investigated the six 1978 issues of JASIS and some other journals considered by the library science librarian at Drexel University to be in the field of information science to provide:

> statistics on the nationality, society memberships, and citation patterns of JASIS and other information science journal authors ... together with data concerning elapsed time between initial receipt of a manuscript and its publication.[184]

In their study, Meadow and Zaborowski conducted a mail survey to collect their data. Two different instruments were mailed. The first went to the 72 authors of the 48 articles published in JASIS in 1978. The second instrument was sent to 100 people considered by the researchers to be the principal authors of 100 articles randomly selected from the information science journals that were selected by the library science librarian.

These core journals are: ASLIB Proceedings, Communications of the ACM, Information Processing and

Management, Information Scientist, Information Systems, Journal of Chemical Information and Computer Science, Journal of Documentation, Journal of Informatics, Online and Online Review.

Fifty-four responses were received from JASIS authors and 71 from the authors of the other journal articles. Forty-three of JASIS authors were from the United States, four from Canada, four from England, two from West Germany and one each from Mexico and Switzerland.

The nationalities of the non-JASIS journals authors were not the same. Forty-two were from the United States, eighteen from England, four from West Germany and one from each of Canada, Sweden, France, Netherlands, Belgium, Israel, and Ireland.

It was found that the majority of JASIS authors (52 out of 54) had published in JASIS in the past three years. Ten of them published in Information Processing and Management. Eight of them published in Social Studies or Science. The major journals in which the authors of the other information science journals had published in the same period were: Information Processing and Management (20 authors), Online (17 authors), and Journal of Chemical Information and Computer Science (16 authors).

Journal of Documentation was cited most by authors of both JASIS and the other information science journals, followed by JASIS (by JASIS's authors), and Journal of Chemical Information and Computer Science by the authors of other information science journals. Information Processing and Management was third for both groups of authors. JASIS was fourth for the authors of articles in other information science journals and ARIST was the fourth highly cited by authors of JASIS articles.

It is possible that other studies about JASIS were performed, but the above studies were the only two identified.

2.4. Interdisciplinarity Studies

Citation analysis, as a data collection technique, has been used in many studies to investigate and examine the structure of some of the interdisciplinary fields.

The political science's bibliographic references were analyzed by Robinson (1973) in his doctoral dissertation at the University of Illinois.[185]

One of the major contributions of his study is the introduction of the subject dispersion of citations which

was defined by Robinson as:

> The degree to which scholars in an academic discipline or subject field borrow literature or information sources from other disciplines .... Thus, subject dispersion becomes an index of subject relationships or de facto interdisciplinary cooperation.[186]

Narin, Pinski, and Gee (1976) investigated the structure of the biomedical journal literature to study the biomedical research activity.[187]

Citation analysis has been used in the study to classify approximately 900 biomedical journals into approximately 50 fields and into four research levels.

The researchers used a hierarchical diagram to explain the influence of 42 disciplines within biomedicine. The list of disciplines includes clinical medicine; such as pharmacology, psychiatry, veterinary medicine, dentistry, etc., and basic research which included many fields; such as parasitology, physiology, biophysics, microbiology, etc.

Several lists and matrix diagrams are presented to display the referencing from four core journals to biomedicine journals.

One of the study findings is that biochemistry and biophysiology were found to be the "twin supporting pillars of all biomedical knowledge."[188]

Neeley (1981) in a cross-citation analysis study found that:

> the management literature is depenent on the social sciences, that it is more dependent on them than vice versa, and that it is more dependent on them than they are on each other.[189]

The objective of the study is to investigate the hypothesis that "the contemporary study of management is found on the social science disciplines."[190] To test the hypothesis, Neeley uses two methods to identify core journals in management and social sciences.

In the first method Bradford's law was used to identify the core journals. In the second method, the core journals were identified based on the opinions of scholars in management and social sciences. The results of the two methods were very similar.

The interdisciplinarity of management was highlighted based on the interdisciplinarity of the literature of management.

Katherine W. McCain (1984) studied the changes in the structure of macroeconomics by using author cocitation mapping.[191] She founds that "author cocitation analysis conducted over successive time periods is a useful tool for studying the changing structure of scholarly disciplines."[192]

Summary of Information Science Literature

It seems that most information science literature older than 1970 focused on some of the applications in the field of information science. The theoretical aspects, generally speaking, attracted less attention.

The 1970's may be considered the period in which information science began to draw the concerns of many people in many different disciplines. In the second half of that decade, the literature of information science began to pay less attention to looking for a "generally acceptable" definitions for information science and its related terms; instead, some of the theoretical and more practical aspects of the field were investigated.

Few doctoral dissertations have been done in information science to help the field to reach better "maturity". However, the literature that comprehensively investigated the nature, the structure and inter-disciplinarity, and the theories of information science did not exist in the 1970's. Linda An's dissertation may be considered to be a good addition to the literature that investigates some of the theoretical aspects of information science.

In the 1980's, a few more Ph.D. dissertations that investigated the discipline of information science were produced. The Afsharpanah study, in particular, was an attempt to explore the structure and the inter-disciplinarity of information science.

It is this researcher's belief that Shahrokh Afsharpanah has contributed greatly to the field of information science by identifying basic disciplines contributing to information science, by exploring the relationships of information science with other fields, and the impacts of the authors of information science on the development and structure of the field. However, it seems that this study should be expanded to cover the years following 1978 to find out if Afsharpanah's findings are still valid.

Also, Schrader added to the literature of information science by collecting and analyzing the definitions of the field.

In 1973, Gerald Jahoda stated that "one can conclude ....that information science means different things to different people."[193] Unfortunately, the literature reviewed provides clear evidence that the Jahoda statement holds true fourteen years after it was published.

CHAPTER III

METHODOLOGY

The tracing of the evolution of an interdisciplinary science; whether social, pure, physical, applied, or any other type, is a complex process due to the invisibility of the structure of the interdisciplinary science and the constantly changing nature of this structure.

To uncover the structure of information science and to monitor the changes in this structure, a reliable technique needs to be used to provide us with a clear idea about what the structure of the field formerly looked like, how it looks now, and perhaps how it will look in the future.

Citation analysis has been chosen as the appropriate technique based on the advantages which were presented and discussed in Chapter Two, section 2.2.

Another serious problem researchers experience in doing this type of study is the problem of selecting the sample source from which to draw data that contain the

citations to be analyzed. The nature of the difficulty is due first to the identification of the "right" literature and second to the unclear scope and boundaries of disciplines like information science. The unbounded concerns of information science made this problem even more complex.

It was of great concern to select the source of data that covers the most important aspects of information science.

James Neeley (1981) used two techniques to select core journals to study the interdisciplinarity of management and its relationships with the social science disciplines. He explained his selection methodology by saying:

> The particular journals which comprise the core have been identified in two ways. The first is based on use, typically measured by the relative frequency with which individual journals are cited in their respective literature. .... A second method of identifying core journals uses subjective evaluation by scholars in the field, typically academics or members of the field's national associations.... the two methods yield similar results.[194]

Based on Neeley's finding, and the absence of a reliable and agreed upon selection method, the researcher decided to conduct a survey to determine which source of data to be examined.

A list of thirty information science experts was compiled on the basis of the experts' contributions to information science over the last twenty-five years; their memberships in the American Society for Information Science; their experiences in teaching information science or managing information science departments, schools, or colleges; and for being editors or on the editorial boards of information science journals.

A letter was mailed to each of the experts. In these letters, the experts were asked to compile a ranked list of the five journals that they consider to be the most representative of information science. It was explained that only one journal would be selected for the study so the expert was told that his/her first selection was assumed to be the most representative of the field from the expert's point of view.

Twenty-five responses were received. The names and work sites of the experts who responded to the letter are displayed in Table 3.1.

Table 3.1

The Names and Work Sites of Information Science Experts Responded to the Researcher's Letter

Abraham Bookstein	Prof., Grad. Library School, Univ. of Chicago
Harold Borko	Prof., Grad. School of Library and Information Science, UCLA
Bert Boyce	Prof., School of Library and Information Science, LSU
Bonnie C. Carroll	Deputy Asst. Manager for Information Services, Dept. of Energy.
William Cooper	Prof., School of Library and Information Science, Univ. of California-Berkeley.
Anthony Debons	Prof., Interdisciplinary Dept. of Information Science, Univ. of Pittsburgh
C.R. Foulk	Prof., Dept. of Computer and Information Science, Ohio State Univ.
Belver C. Griffith	Prof., College of Information Studies, Drexel Univ.
Stephen P. Harter	Prof., School of Library and Information Science, Indiana Univ.
Robert M. Hayes	Dean, School of Library and Information Science, UCLA
Gerald Jahoda	Prof., School of Library and Information Studies, FSU
Allen Kent	Prof., School of Library and Information Science, Univ. of Pittsburgh.

Manfred Kochen	Prof., Univ. of Michigan.
F.W. Lancaster	Prof., Grad. School of Library and Information Science, Univ. of Illinois.
R.S. Marcus	Laboratory for Information and Decision Systems, MIT.
Gerard Salton	Prof., Dept. of Computer Science, Cornell Univ.
Tefko Saracevic	Prof., School of Communication, Information and Library Studies, Rutgers.
Henry Small	Information Science Institute.
Linda Smith	Prof., Grad. School of Library and Information Science, Univ. of Illinois.
Danny P. Wallace	Prof., School of Library and Information Science, LSU
Herbert White	Dean, School of Library and Information Science, Indiana Univ.
James Williams	Prof., Interdisciplinary Dept. of Information Science, Univ. of Pittsburgh.
Martha Williams	College of Engineering, Univ. of Illinois.
Lawrence A. Woods	Manager, Product Development Library Systems, McDonnell Douglas Computer Systems Co.
Pranas Zunda	Prof., School of Information and Computer Science, Georgia Institute of Technology.

Most of the experts compiled lists of five journals and few presented lists with fewer than five titles. Others compiled lists with more than five titles. In the latter cases, only the first five titles were considered. One response presented no list of journals, instead the expert indicated that it was impossible to select such a list.

Five points were given to each first selection on each list; four points to the second selection; three points to the third selection; two points to the fourth and, one point to the last selection.

In one case, an expert selected two journals to be the first selection. In this case each journal was awarded 4.5 points.

The score each journal received and the number of times each was the first choice are shown in Table 3.2.

The Journal of the American Society for Information Science, (JASIS) was the only journal that was selected by all information science experts. It was one of five journals to be selected as a first choice. It was the first choice twenty-one times.

Based on the experts' opinions, JASIS was selected to be the source of data for this study.

Table 3.2
The Selected Information Science Journals According to their Ranks

Title	Times 1st Sel.	Times Selected	Points	Rank
JASIS	21	25	114.5	1
IPM	0	17	57	2
J. Doc.	2	16	51.5	3
J. of Inf. Sc.	0	8	19	4
Comm. of the ACM	0	6	17	5
J. of the ACM	0	4	9	6
Inf. Tech. & Libraries	1	2	8	7
IBM Journal of R&D	0	2	7	8
Nauchno-Tekhnicheskaia Informacia	1	2	7	8
Res. in Lib. & Inf. Sc.	0	2	7	8
Computer World	0	2	6	11
Datamation	1	2	6	11
Scientometrics	0	2	6	11
Online Review	0	3	5	14
Knowledge	0	1	4	15
Sigir Forum	0	2	4	15
J. of Ed. for Lib. & Information Sc.	0	1	3	17
Library Hi Tech	0	1	3	17
ARIST	0	2	2	19
ASLIB Journal	0	1	2	19
BASIS	0	2	2	19
Int. J. of Man-Machine Studies	0	1	2	19
Library Quarterly	0	1	2	19
MIS Quarterly	0	1	2	19
Scientific America	0	1	2	19
ASLIB Proceedings	0	1	1	26
BYTE	0	1	1	26
IEEE Trans. on Sys, Man & Cybernetics	0	1	1	26
Int. Forum on Inf. & Doc.	0	1	1	26
Nachrichten fur Dokumentation	0	1	1	26
Online	0	1	1	26
Total number of journals				31
Total number of journals as first choice				5

Two other factors influenced the selection decision: the high circulation of JASIS, and the large number of abstracts and indexes that cover it. Table 3.3 shows the circulation figures of the major information science journals.[200]

Table 3.3
Information Science Periodicals

TITLE	CIR.	# OF IND/ABS.	COUNTRY OF PUB.	# OF ISSUES A YEAR
ASLIB Information	2500	1	GB	12
ASLIB Proceedings	3500	10	GB	12
BASIS	5000	8	USA	6
Bibliotekar	5500	1	Bulgaria	12
Informatica & Documentazione	2000	1	Italy	4
IPM	2000	11	GB	6
Information Und Dokumentation: Annotierte Titelliste	1500		DDR	4
Informatologia Yugoslavia	600	3	Yugoslavia	4
JASIS	**5968**	**16**	**USA**	**6**
J. of Doc.	3500	11	GB	4
J. of Inf. Pro. & Mang.	2800	2	Japan	12
J. of Inf. Sc.	3000	12	GB	8

3.1. Journal of the American Society for Information Science (JASIS)

In 1938, the American Library Association began to publish a journal to deal with some technical aspects of libraries. That journal was entitled Journal of Documentary Reproduction. It was identified as "a quarterly review of the application of photography and allied techniques to library, museum, and archival service."[195] The last issue of this journal was published in 1943.

In 1950, the defunct Journal of Documentary Reproduction was followed by the American Documentation Institute's publication American Documentation (AD).

AD was identified as "A quarterly review of ideas, techniques, problems and achievements in documentation."[198] After the American Documentation Institute changed its name to the American Society for Information Science (ASIS) in 1968, ASIS became the new sponsoring organization of AD in January, 1968.

Beginning with the first issue of the twenty-first volume of AD (January-February 1970) the title of the journal was changed to the Journal of the American Society for Information Science (JASIS), and it became a bimonthly publication as it remains today.

In their "Instructions to Authors", the editorial board of the first issue which carried the title JASIS indicated that JASIS "is a scholarly journal in the various fields in documentation and serves as a forum of discussion and experimentation."[197] A.W. Elias, a former editor of JASIS, states that JASIS "represents a growing and vital science, developing a theoretical base and applying these theories to practice for the general good."[198]

In defining the scope of JASIS, Donald Kraft, the current editor of the journal indicates that JASIS "is a refereed journal whose scope includes all of the wide fields of information systems, information science, and aspects of library science."[199] The range of interests of the journal is defined by Kraft in five major subject headings.

These five major subject headings include thirty-two sub-headings. All major and sub-headings included are:

1. Theory of information science
   - 1.1 Foundations of information science
   - 1.2 Information theory
   - 1.3 Bibliometrics
   - 1.4 Information retrieval--models and principles
   - 1.5 Evaluation and measurement
   - 1.6 Representation, organization, and classification of information

1.7 Artificial intelligence and natural language processing

2. Communication
   - 2.1 Theory of communication
   - 2.2 Nonprint media
   - 2.3 Man-machine interaction
   - 2.4 Network design, operation, and management
   - 2.5 Models and empirical findings about information transfer
   - 2.6 User and usage studies

3. Management, economics, and marketing
   - 3.1 Economics of information
   - 3.2 Management of information systems
   - 3.3 Models of information management decisions
   - 3.4 Marketing and market research studies
   - 3.5 Special clientele. This includes arts and humanities, biological and chemical sciences, legal, education, behavioral and social sciences, medical sciences, and energy

4. Applied information science
   - 4.1 Information systems design--tools, principles, applications
   - 4.2 Case histories
   - 4.3 Information systems operations
   - 4.4 Standards
   - 4.5 Information technology - hardware and software
   - 4.6 Automation of information systems
   - 4.7 Office automation and record management

5. Social and legal aspects of information
   - 5.1 Impact of information systems and technology upon society
   - 5.2 Ethics and information
   - 5.3 Legislative and regulatory aspects
   - 5.4 History of information science
   - 5.5 Information science education
   - 5.6 International issues

The list appears to include most of the aspects of information science.

Finally, JASIS was indexed and abstracted in sixteen different indexing and abstracting tools. These include Science Citation Index, Current Contents, Chemical Abstracts, Social Science Citation Index, Library and Information Science Abstracts, etc. This large number of indexes and abstracts is another evidence of the wide coverage of the journal.

3.2. Plan of the Study

Citation analysis is used in this study to examine the interdisciplinarity of information science and to identify the importance of each contributory field in creating this interdisciplinarity. The investigation of the changing positions of different disciplines as contributors to information science is also investigated.

Data for the study is collected through analyzing randomly selected sample of references from all the articles of the Journal of the American Society for Information Science, JASIS, published during the period January, 1970 (the first issue of the journal which carried the current title) through December, 1985.

The population of this study is the references listed in all JASIS articles published in the ninety-six issues of the sixteen volumes of the journal published between January, 1970 and December, 1985.

3.3. Sampling Technique

It was clear that the size of data population available to this study is very large (over 12,000 references) so a decision was made to select a random sample of reasonable size with the understanding that an acceptable statistical error will occur.

The literature that was reviewed and consulted did not provide one generally acceptable technique to select a sample for this type of study, nor did it present one agreed upon size of such a sample.

Ary, Jacobs and Razavieh (1979) indicate that :

> There is no single rule that can be used to determine sample size....descriptive research typically uses larger samples; it is sometimes suggested that one select 10-20 percent of the accessible population for the sample.[201]

Vicki Sharp in her publication Statistics for the Social Sciences (1979) states that:

> Generally speaking, that if you are dealing with a small population, say 100, you should use 50% of your population. As the population increases, smaller proportions are adequate. For example, if you had a population of 10,000, 10% would be sufficient for a sample.[202]

Moreover, Afsharpanah's study used a 10% sample from the Annual Review of Information Science and Technology to study the interdisciplinary structure of information science[203].

Based on these studies and opinions, the sample for this study was set at 10% of the population. The total number of references appearing in the ninety-six issue of JASIS published between January, 1970 and December, 1985 is 12,005.

References at the end of "Letters to the Editor", "The Editor's Notes", "Book Reviews", "Information for Contributors", and similar texts are not included in either the population or the sample.

Articles were assigned numbers based on their appearance in any particular year. The first article appearing in the first issue of each year was given the number 01, the second article was given the number 02, and so on.

The same procedure was followed in numbering the references in each article.

Since some articles have more than 99 references, a three digit number was given to each reference in each article. For example, the 10th reference in the 34th article in any given year carried the number 34010. The first two digits represent article number and the last three digits represent the reference number.

Table 3.4 shows the total number of references and the sample size in each year of the study.

Table 3.4

The Population and the Sample Size by Years

Year	Total Number of References	Sample
1970	377	38
1971	622	62
1972	767	77
1973	645	65
1974	737	74
1975	556	56
1976	782	78
1977	608	61
1978	591	59
1979	632	63
1980	790	79
1981	1,217	122
1982	851	85
1983	1,028	103
1984	769	77
1985	1,033	103
TOTAL	**12,005**	**1,202**

Only references to journal articles or books are examined in this study. Conference proceedings, reports, unpublished works, etc., are not included in the sample.

Afsharpanah (1983) points out that journal articles

> reflect different aspects and subfields of information science theory and practice, and

> each article finds its way into a journal after its content and its relevance to a given problem have been evaluated through the editorial and peer review processes.[204]

However, it is the researcher's belief that books are just as important as journals to provide any disciplines literature, thus they are included in the sample.

Serial publications, such as Annual Review of Information Science and Technology, ARIST, have been treated in the analysis as if they were journals because of its periodic nature which is more like a journal than it is like a monograph.

Stratified sampling is used to select the sample for the study. Stratified sampling is explained by some experts as:

> When the population consists of a number of subgroups or strata that may differ in the characteristics being studied, it is often desirable to use a form of sampling called stratified sampling[205].

The study period is divided into sixteen subperiods (strata). Each stratum covered the issues of JASIS for one year.

References that are investigated in each stratum are randomly selected as follows:

1. A number is assigned to each reference.

2. From the table of random numbers, the numbers of the references to be investigated in each year are drawn.

3. Since only references to journals and books are included in the study, the references from other sources are not investigated. If the number drawn from the table of random numbers is a reference from another source it is ignored and another number is selected.

4. Books and journals which carry the term "information" without connecting it to another field (e.g. "chemical information, information and library science", etc.) are labeled "IS" and they are considered as information science materials. This decision was made because it is believed that most of information science literature was classified under headings such as "Indexing and Abstracting", "Documentation", " Library and Information Science", etc., which, may no longer be valid. For this study information science is not a part of library science, documentation, indexing and abstracting, etc.

5. The titles of the rest of the journals are checked in Ulrich's International Periodicals Directory to find the Dewey Decimal Classification (DDC)[206] number of the journal.

6. The title of each book not included in "3" above is checked in OCLC[207] to find its DDC number.

7. Computer science journals are labeled CS because, as in the information science case, computer science was treated as part of knowledge (001) or electrical engineering (621.38). Computer science books are treated as were information science books.

8. Journals in documentation (025 and 029) are labeled IS (for information science).

9. In addition to information science and computer science literature, the literature of communications (001.51), and chemical engineering (660) are classified individually; communication, because it was expected to be a major contributor to information science; and chemical engineering because in DDC chemical engineering is an independent class (Dewey, 1979).

10. Artificial intelligence (DDC 001.535) is considered to be part of computer science (CS).

11. After all references are listed under their subject headings, DDC is used to normalize subjects of data.

Under this normalization, subject headings are related to the one hundred major subdivisions of the ten branches of knowledge listed by Dewey except for the fields discussed in 4-9 above.

3.4. Data Analysis

After data are collected and the contributory disciplines in each group are identified, the frequencies and percentages of contribution of each discipline in each period are calculated. Since the type of measurement in this study is nominal, the researcher has used descriptive statistics to answer the research questions.

Diagrams and other graphs are used to present the data. Modes, medians, frequencies, and other suitable measures are used in analyzing the data for the study.

CHAPTER IV

DATA PRESENTATION AND ANALYSIS

4.1. Introduction

The data were collected and analyzed to reach the two basic goals:

1. To describe the interdisciplinarity of information science on the basis of the reference patterns in the Journal of the American Society for Information Science, JASIS.

2. To identify the changes in this interdisciplinarity based on the changes in the sources of the references in JASIS.

The data were analyzed to identify the disciplines that contributed to the information science literature, as presented in JASIS, and to determine the percentages of the contribution of each discipline on an annual basis and for each of three multi-year periods.

Descriptive statistics were used to identify the contributions of the different disciplines and the changes in these contributions.

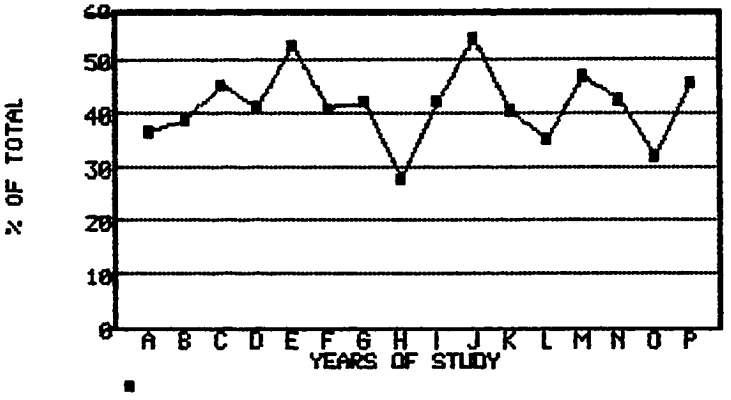
4.2. General Analysis

Thirty-two disciplines were identified as contributing references cited by JASIS articles from the sample selected from the 12,005 references of the articles published in JASIS during January, 1970 through December, 1985. Table 4.4 shows these disciplines according to their contributions.

In 1977, information science had contributed the least to its literature (27.87% of total contribution). In 1979, information science contribution to its literature was the highest at 53.97%. However, as it is shown in Appendix B, the contribution of information science to its literature has decreased slightly during the study periods.

The contribution of information science to the literature that was investigated was 43.8% of total contribution during the first study period (1970-1974). This contribution decreased to 41.63% of total contribution during the second study period (1975-1979). This figure decreased again to 40.6% during the third study period (1980-1985). Figure 1 shows the changes of information science contribution during the study period.

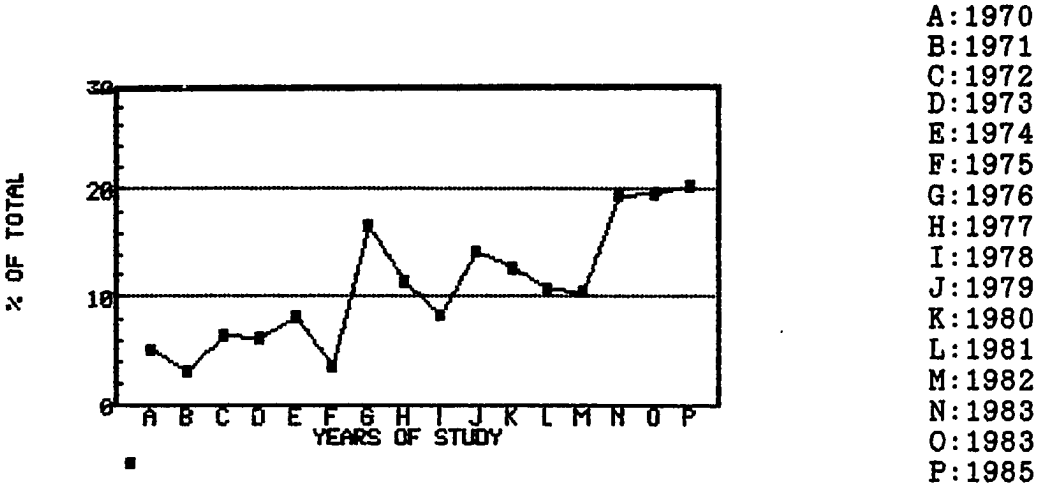
Figure 1: The Changes in the Contribution of Information Science to its Literature Through the Period 1970-1985



A:1970
B:1971
C:1972
D:1973
E:1974
F:1975
G:1976
H:1977
I:1978
J:1979
K:1980
L:1981
M:1982
N:1983
O:1984
P:1985

During the first study period only 6.02% of JASIS citations came from computer science literature. This contribution increased to 11.35% during the second period and 17.43% during the third study period. In total, information science literature published in JASIS between 1970 through 1985 received 12.81% of its citations from computer science. This contribution makes computer science the second highest contributor to information science literature after information science itself. Figure 2 shows the changes of the contribution of computer science to the literature of information science during the period January, 1970 through December, 1985.

Figure 2: The Changes in the Contribution of Computer Science to Information Science Literature Through the Period 1970-1985

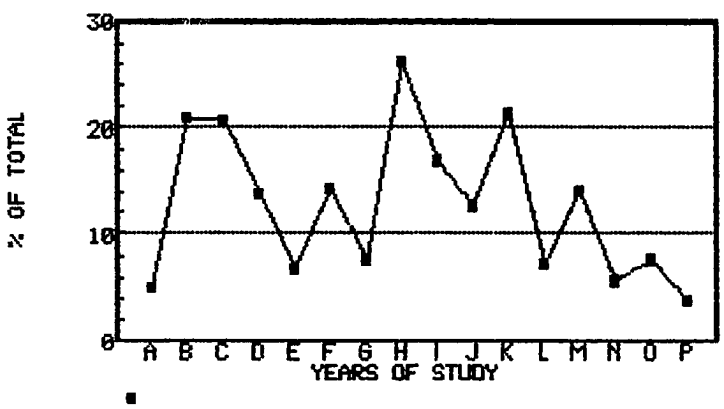


Library science was found to be the third highest contributor to information science literature investigated in this study. However, library science's contribution has decreased sharply during the last few years.

As it is shown in Appendix B, 14.28% of the references that were cited by the authors of information science literature came from library science during tne first study period (1970-1974). This percentage relatively increased to 15.13% during the second period of the study (1975-1979), but the percentage sharply decreased to 9.3% during the third study period (1980-1985).

In 1985 there was an all-time low with only 3.9% of information science citations coming from library science. Figure 3 shows these changes.

Figure 3: The Changes in the Contribution of Library Science to the Literature of Information Science Through the Period 1970-1985



A:1970
B:1971
C:1972
D:1973
E:1974
F:1975
G:1976
H:1977
I:1978
J:1979
K:1980
L:1981
M:1982
N:1983
O:1984
P:1985

The fourth highest contributor to information science literature was general science (DDC 500-509). In total, 9% of the citations in the information science literature investigated came from general science.

The general science contribution to information science during the first period was relatively low (5.71%). During the second period, information science

citations from general science were 10.71% of total citations. This percentage relatively decreased to 9.84% during the third period.

Information science, computer science, library science, and general science were found to be the only disciplines that contributed to the literature of information science every year during the sixteen years of this study. Three disciplines; psychology, management, and chemistry appeared in fourteen years of the sixteen years of the study.

Psychology was ranked the fifth highest contributor to the literature of information science since. 3.74% of the citations investigated came from psychology literature. Psychology's contribution was relatively high during the first period of the study (4.76%). This contribution decreased to 1.57% in the second period, but increased to 4.4% in the third period.

During the period of the study, management contributed 3.08% of information science citations and was ranked the sixth highest contributor. Management contributed continuously to information science from 1977 to 1985.

Chemistry, with 2.75% of the total number of

citations of the study, was ranked as the seventh highest contributor. However, this high contribution may not be counted as an indicator of a strong relationship between information science and chemistry. Most of the chemistry citations came from only one journal, the Journal of Chemical Documentation which later became the Journal of Chemical Information and Computer Science.

Based on the topics covered by the Journal of Chemical Information and Computer Science, it might be more reasonable to classify JCICS as an information science journal rather than a chemistry journal.

Other disciplines found to be contributors of information science citations are: sociology (1.08%), knowledge (1.08%), education (1.08%), engineering (except chemical engineering (1%), medical science (.8%), linguistics (.75%), communication (.75%), chemical engineering (.58%), political science (.5%), languages-general (.5%), law (.5%), journalism and publishing (.42%), social sciences-general (.42%), biology (.42%), general periodicals (.33%), philosophy (.07%), commerce (.07%), agriculture (.07%), literature (.07%), and photography (.07%).

As it is shown in Appendix B, the contributions of

the eight disciplines (information science, computer science, library science, science-general, psychology, management, chemistry, and mathematics) were 83.46% of the total contribution during the first period of study. They increased to 89.42% during the second period of study, but they decreased to 88.52% of the total during the last period of study.

It was found that the eight disciplines above contributed about 89% of the citations that were investigated (these disciplines are considered to be the major contributors to the information science inter-disciplinarity). The remaining twenty-four disciplines contributed about 11% of the citations.

Four disciplines (information science, computer science, library science, and general science) contributed about 76% of information science citations included in the sample of this study.

4.3. Book Citations

There were 240 book citations in the sample or 20% of the 1,202 citations that were included.

The distribution of book citations was found to be

different from the distribution of total citations and journal citations. The information science citations from books, are the highest; it contributed 34.71% of total book citations. As indicated earlier, information science contributed 41.76% to the total contributions and contributed 43.54% to the journal citations.

Library science is the second largest contributor of book citations to the literature of information science. It contributed 11.76% of the total book citations examined.

General science, DDC 500-509.99, was the third highest contributor of book citations with 9.92% of the total; it followed by computer science with 9.1%, mathematics and statistics (7.85%), management (4.96%), psychology (3.31%), knowledge, communication and sociology with 2.89% each, economics and law with 1.56% each, chemistry and language-general with 1.24% each, education and linguistics at the 15th position with .83% each, and finally in last positions were biology, engineering (except chemical engineering), medical sciences, photography, political science, and social sciences-general with .41% each.

Out of the thirty-two disciplines found to be contributors of citations to information science, only twenty-two disciplines contributed book citations.

Table 4.1 shows the numbers, percentages of book citations, the ranks, and the cumulative contributions of disciplines that were found to be the contributors of book citations to information science.

Appendix C shows the different disciplines' contributions of books citations to information science by years and study periods.

Five disciplines: information science, library science, science-general, computer science, and mathematics and statistics contributed 73.34% of all book citations that were examined. On the other hand, six disciplines: biology, engineering, medical sciences, photography, political science, and social sciences-general contributed only 2.46% of all book citations.

Table 4.1

Contributions of Book Citations
to Information Science (1970-1985)

DISCIPLINE	No. of CIT.	%	RANK	Cumulative
Information Science	84	34.71	1	34.71
Library Science	28	11.76	2	46.47
Science-general	24	9.92	3	56.39
Computer Science	22	9.10	4	65.49
Math. & Statistics	19	7.85	5	73.34
Management	12	4.96	6	78.30
Psychology	8	3.31	7	81.61
Knowledge	7	2.89	8	84.50
Communication	7	2.89	8	87.39
Sociology	7	2.89	8	90.28
Economics	4	1.56	11	91.84
Law	4	1.56	11	93.40
Language-general	3	1.24	13	94.64
Chemistry	3	1.24	13	95.88
Education	2	.83	15	96.71
Linguistics	2	.83	15	97.54
Biology	1	.41	17	97.95
Engineering*	1	.44	17	98.36
Medical Sciences	1	.41	17	98.77
Photography	1	.41	17	99.18
Political Science	1	.41	17	99.59
Social Sc.-general	1	.41	17	100.00
TOTAL	**240**	**100.00%**		

*Chemical Engineering is not included.

4.4. Journal Citations

Nine hundred and sixty-two citations (80% of the total number of citations) included in the sample are journal citations. These citations come from thirty-one different disciplines. With the exception of photography, which contributed one book citation, all disciplines that contributed to information science literature, as represented by JASIS during the period January, 1970 through December, 1985 were contributors of journal citations.

Three disciplines: information science, computer science, and library science contributed about 70% of the journal references that were cited by information science authors of JASIS articles during the period January, 1970 through December, 1985.

For journal citations, information science, again, is the highest contributor to its literature with 43.54% of the total number of journal citations.

The second highest contributor of journal citations is computer science with 13.73% of the total. The contribution of computer science changed markedly during the study periods.

During the period 1970-1974, 6.55% of journal

citations came from computer science. During the second period (1975-1979), 12.53% of the journal citations came from computer science. During the last period of this study (1980-1985), 17.97% of journal citations came from computer science.

The contribution of library science also changed during the study period. A considrable decline in the number of citations contributed by library science journals to information science literature became apparent during the first half of the 1980's. During the first study period, library science contributed 14% of the journal citations examined. This contribution relatively increased to 16.6% during the second study period, but decreased to only 9.1% during the third study period. These figures show that information science authors are changing their sources of citations from library science to computer science. This may be an indication of the kinds of subjects covered by information science authors in the 1970's and the kinds of subjects covered by them in the 1980's. In 1971, the contributions of information science, computer science, and library science were 35.9%, 5.1%, and 2.3% respectively. Figures for 1985 were 47%, 19.5%, and 2.3% for the same three disciplines.

The other high contributor of journal citations to information science are: general science, psychology, chemistry, management, and the rest of the thirty-one disciplines.

As indicated previously, the contribution of chemistry came mostly from one journal, the Journal of Chemical Documentation (JCD) which later became the Journal of Chemical Information and Computer Science (JCICS).

Table 4.2 shows the journal citation contributions of both information science and chemistry as if JCD and JCICS were classified as chemistry journals then as if they were classified as information science journals. However, all the tables and other forms that represent the data of this study treated JCD and JCICS as chemistry journals.

Table 4.3 shows journal citations contributed by different disciplines to information science during the entire study period.

Appendix D shows the contributions of all disciplines that contributed journal citations to information science, by the years of study (1970-1985), and by the three study periods: 1970-1974; 1975-1979; and 1980-1985.

Table 4.2

The Changes in the Contribution of Chemistry Based on the Classification of JCD and JCICS

Year	Chemistry				Information Science			
	Chem.		IS		Chem.		IS	
	No.	%	No.	%	No.	%	No.	%
1970	4	16.0	11	44.0	0	0.0	15	60.0
1971	1	2.6	14	35.9	0	0.0	15	38.5
1972	1	1.6	30	48.4	0	0.0	31	50.0
1973	1	2.4	17	41.5	1	2.4	17	41.5
1974	3	4.8	32	51.7	1	1.7	34	55.1
70-74	**10**	**4.4**	**104**	**45.4**	**2**	**.9**	**112**	**48.9**
1975	1	2.1	22	46.8	0	0.0	23	49.0
1976	7	10.0	31	44.3	2	2.9	36	51.4
1977	3	5.5	15	27.3	0	0.0	18	31.8
1978	1	2.0	22	44.0	0	0.0	23	46.0
1979	0	0.0	26	53.1	0	0.0	26	53.0
75-79	**12**	**4.4**	**116**	**42.9**	**2**	**.7**	**126**	**46.5**
1980	2	3.2	27	45.3	0	0.0	29	49.2
1981	1	1.0	38	38.8	0	0.0	39	39.8
1982	1	1.6	29	46.0	0	0.0	30	47.6
1983	1	1.1	39	42.9	1	1.1	39	42.8
1984	0	0.0	24	37.5	0	0.0	24	37.5
1985	2	2.3	41	47.0	0	0.0	43	49.3
80-85	**7**	**1.5**	**198**	**42.9**	**1**	**.2**	**204**	**44.2**
TOTAL	**29**	**3.0**	**418**	**43.5**	**5**	**.5**	**442**	**46.0**

Table 4.3

Contributions of Journal Citations to Information Science (1970-1985)

Discipline	No. of Cit.	%	Rank	Cumulative
Information Sc.	418	43.54	1	43.54
Computer Science	132	13.74	2	57.28
Library Science	119	12.40	3	69.68
Science-general	84	8.75	4	78.43
Psychology	37	3.85	5	82.28
Chemistry	29	3.00	6	85.28
Management	25	2.60	7	87.88
Economics	11	1.14	8	89.02
Education	11	1.14	8	90.16
Engineering*	11	1.14	8	91.30
Sociology	10	1.03	11	92.33
Medical Sc.	9	.92	12	93.25
Chem. Engineering	8	.81	13	94.06
Linguistics	7	.71	14	94.77
Knowledge	6	.61	15	95.38
Math. & Statistics	6	.61	15	95.99
Political Science	5	.51	17	96.50
Publishing	5	.51	17	97.01
Biology	4	.40	19	97.41
General	4	.40	19	97.81
Physics	4	.40	19	98.21
Social Sc.-general	4	.40	19	98.61
Languages	3	.31	23	98.92
Communication	2	.21	24	99.13
Law	2	.21	24	99.34
Agriculture	1	.11	26	99.45
Botany	1	.11	26	99.56
Commerce	1	.11	26	99.67
Geology	1	.11	26	99.78
Literature	1	.11	26	99.89
Philosophy	1	.11	26	100.00
Total	**962**	**100.00**		**100.00**

*Chemical Engineering is not included.

4.5. Answers to Research Questions

This section will summarize the data that were provided in the previous sections of this chapter to answer the research questions of the study.

The first research question of the study was:

What are the disciplines that contributed to information science between 1970 and 1985?

Thirty-two disciplines were identified as contributors to information science literature published in JASIS during the period January, 1970 through December, 1985. Table 4.4 provides a display of the number of the citations contributed by the thirty-two disciplines and the percentages of these contributions. Appendix B presents the contributions of all these disciplines.

The figures in Table 4.4 show that information science itself was the major contributor to its own literature during the study period.

Four disciplines; information science, computer science, library science, and general science were the only disciplines with continuous annual contribution. Other disciplines with relatively high contributions during the study period were: psychology, management, mathematics and statistics, and chemistry. Some problems associated with the classification of the contribution of chemistry were discussed in section 4.4 of this chapter.

TABLE 4.4

The Contributions of Different Disciplines to Information Science (1970-1985) by Their Ranks

DISCIPLINE	TOTAL CONTRIBUTION No. of Cit.	% of total	Rank	Cum.
Information Science	502	41.76	1	41.76
Computer Science	154	12.81	2	54.57
Library Science	147	12.20	3	66.77
Science-General	108	9.00	4	75.77
Psychology	45	3.74	5	79.51
Management	37	3.07	6	82.58
Chemistry	32	2.68	7	85.26
Mathematics & Statistics	25	2.07	8	87.33
Sociology	17	1.41	9	88.74
Economics	15	1.28	10	90.02
Education	13	1.08	11	91.10
Knowledge	13	1.08	11	92.18
Engineering*	12	1.00	13	93.18
Medical Sciences	10	.80	14	93.98
Communication	9	.74	15	94.72
Linguistics	9	.74	15	95.46
Chemical Engineering	8	.65	17	96.11
Languages-General	6	.50	18	96.61
Law	6	.50	18	97.11
Political Science	6	.50	18	97.61
Biology	5	.42	21	98.01
Journalism & Publishing	5	.42	21	98.39
Social Sciences-General	5	.42	21	98.85
General Periodicals	4	.32	24	99.17
Physics	4	.32	24	99.49
Agriculture	1	.07	26	99.56
Botany	1	.07	26	99.63
Commerce	1	.07	26	99.70
Geology	1	.07	26	99.77
Literature	1	.07	26	99.83
Philosophy	1	.07	26	99.90
Photography	1	.07	26	100.00
TOTAL	**1202**	**100.00**		**100.00**

*Chemical Engineering is not included.

The second research question was:

How did the contributions of different disciplines to information science change between 1970 through 1985?

The information provided by the analysis of the data indicates that during the study period, the contribution of information science to its own literature did not change markedly. However, a slight decrease in this contribution is detected. The same information indicate that the most marked changes are detected in the contributions of two disciplines; library science and computer science.

A clear increase in the contribution of computer science is identified. During the first half of the 1970's (the first study period), only 6.02% of references cited by authors of information science articles published in JASIS during that period come from computer science literature. This figure increased to 11.35% in the second half of the 1970's (the second study period). In the first half of the 1980's (the third study period), this contribution increased to 17.43% of the total number of materials cited by the authors of JASIS articles. In the last three years of the study; 1983, 1984, and 1985

computer science contributed 19.42%, 19.5%, and 20.4% of references cited by information science authors respectively.

Based on these figures, it was found that the contribution of computer science to information science had increased by 88% between the first and second study periods. It had increased by 53% between the second and third periods. In general, computer science contribution increased by 190% between the first half of the 1970's and the first half of the 1980's.

On the other hand, the contribution of library science decreased by 38% between the second and third study periods (from 15.13% to 9.4%). However, this contribution increased by about 6% between the first and second study periods (14.28% to 15.13%).

The contribution of science-general increased by 88% between the first and second periods (5.71% to 10.72%). It had decreased by 8% between the second and third study periods (from 10.72% to 9.84%).

Table 4.5 shows the changes in the contributions of the five highest contributors to the field of information science through out the study period.

Data displayed in Appendices B and E provide

information on the changes of the contributions of the all the contributors to the interdisciplinarity of information science during the period 1970 through 1985.

Table 4.5

The Annual Contributions of the Five Highest Contributors to Information Science (1970-1985)

Year	IS	CS	LS	Sc	Psy
1970	36.90	5.20	5.20	13.20	2.60
1971	39.00	3.20	21.00	4.80	4.80
1972	45.50	6.50	20.80	3.90	1.30
1973	41.50	6.13	13.80	4.65	10.70
1974	52.70	8.12	6.80	5.40	4.00
70-74	**43.80**	**6.02**	**14.28**	**5.71**	**4.76**
1975	41.10	3.58	14.30	10.70	5.36
1976	42.30	16.67	7.70	11.54	0.00
1977	27.87	11.48	26.23	8.20	1.64
1978	42.36	8.47	16.95	13.56	1.70
1979	53.97	14.29	12.70	9.52	0.00
75-79	**41.63**	**11.35**	**15.13**	**10.72**	**1.57**
1980	40.50	12.65	21.50	6.33	2.53
1981	35.25	19.76	7.35	11.48	6.56
1982	47.06	10.59	14.11	10.59	2.35
1983	42.72	19.42	5.83	8.74	2.91
1984	32.47	19.50	7.80	16.83	5.20
1985	45.70	20.40	3.90	5.83	5.83
80-85	**40.60**	**17.43**	**9.40**	**9.84**	**4.40**
TOTAL	**41.76**	**12.81**	**12.20**	**9.00**	**3.74**

IS: Information Science
CS: Computer Science
LS: Library Science
Sc: General Science
Psy: Psychology

The third research question was:

Which disciplines are the major contributors to the information science literature in the periods 1970-1974, 1975-1979, and 1980-1985?

For the purpose of this study, the highest eight disciplines that contributed to information science during each period of the three periods of the study will be considered as the "major contributors". From the data that were collected and analyzed the major contributors to information science are presented in tables 4.6, 4.7, 4.8, and 4.9.

Table 4.6 shows the contributions of the highest eight disciplines to information science during the first study period (1970-1974). Table 4.7 shows the contributions during the second study periods (1975-1979). Table 4.8 shows the contributions of the major contributors during the last study period (1980-1985). Table 4.9 shows the contributions of the major contributors during the entire study period (1970-1985).

Table 4.6

The Major Contributors
to Information Science (70-74)

Disciplines	No. of Cit.	%	Rank	Cum.
Information Sc.	139	43.81	1	43.81
Library Science	45	14.28	2	58.09
Computer Science	19	6.02	3	64.11
General Science	18	5.71	4	69.82
Psychology	15	4.80	5	74.62
Chemistry	12	3.81	6	78.43
Management	8	2.54	7	80.97
Math. & Stat.	8	2.54	7	83.51
TOTAL	**264**	**83.51%**		

Table 4.7

The Major Contributors
to Information Science (75-79)

Disciplines	No. of Cit.	%	Rank	Cum.
Information Sc.	132	41.63	1	41.63
Library Science	48	15.13	2	56.76
Computer Science	36	11.35	3	68.11
Science-general	34	10.72	4	78.83
Management	13	4.10	5	82.93
Chemistry	12	3.76	6	86.69
Psychology	5	1.57	7	88.26
Education	4	1.26	8	89.52
Linguistics	4	1.26	8	90.78
TOTAL	**288**	**90.78%**		

Table 4.8

The Major Contributors to Information Science (80-85)

Disciplines	No. of Cit.	%	Rank	Cum.
Information Sc.	231	40.60	1	40.60
Computer Science	99	17.43	2	58.03
Science-general	56	9.84	3	67.87
Library Science	54	9.40	4	77.27
Psychology	25	4.40	5	81.67
Management	16	2.81	6	84.48
Math. & Stat.	14	2.46	7	86.94
Sociology	10	1.76	8	88.70
TOTAL	**505**	**88.70%**		

Table 4.9

The Major Contributors to Information Science (70-85)

Disciplines	No. of Cit.	%	Rank	Cum.
Information Sc.	502	41.76	1	41.76
Computer Science	154	12.81	2	54.57
Library Science	147	12.20	3	66.77
Science-general	108	9.00	4	75.77
Psychology	45	3.74	5	79.51
Management	37	3.07	6	82.58
Chemistry	32	2.68	7	85.26
Math. & Stat.	25	2.07	8	87.33
TOTAL	**1050**	**87.33%**		

4.6. Additional Bibliometrical Findings

Many findings that were not directly related to this study were recognized during the analysis of data. Because these findings may be helpful highlighting some aspects of information science, they will be presented in this section.

1. Language of citations: From journals and books, as may be expected, English was found to be the language of most of the materials that were cited by the authors of JASIS articles during the period January, 1970 through December, 1985. All citations from computer science and library science that were examined were in English. This does not mean that materials in other languages had not been cited at all, it simply means that no material in any language other than English was included in the study sample.

Table 4.10 shows the number and percentages of citations in different languages arranged by the disciplines which contributed these citations.

It is important to indicate that there is a possibility that other materials in different languages were cited by the authors of JASIS articles but these citations were not part of the sample that was examined.

Table 4.10

Languages of the Sources of JASIS Citations

Dis.	A	E	F	G	R
C.S	0	154	0	0	0
I.S.	0	502	0	0	0
L.S.	0	147	0	3	0
Science	1	107	0	0	0
TOTAL	**1**	**910**	**0**	**0**	**0**
Others	0	286	1	0	1
All	**1**	**1196**	**1**	**3**	**1**

Language: A:Arabic, E: English, F: French, G: German, R: Russian.

2. Countries of the cited journals: As expected, most of the journal citations were examined came from materials published in the United States. More than 75% of the citations came from United States journals. England contributed about 23% of the citations. Citations from periodicals that were published in the Netherlands were about 2% of the total.

Table 4.11 shows the contributions of citations by countries of publication. The charts that follow present some of the data that shown in Table 4.11.

Table 4.11

Countries That Published the Sources of JASIS Citations Divided by Disciplines

Country	C.S.	I.S.	L.S.	Sc.	Oth.	All
Australia	0	0	0	0	2	2
Belgium	0	0	0	0	1	1
Canada	1	1	0	0	4	6
Egypt	0	0	0	1	0	1
France	0	0	1	0	1	2
England	19	150	16	14	18	217
India	0	0	0	0	4	4
Luxembourg	1	0	0	0	0	1
Netherlands	2	1	1	12	1	17
New Zealand	0	0	0	0	1	1
USA	109	263	101	57	176	706
USSR	0	0	0	1	0	1
W.Germany	0	3	0	0	0	3
Total	**132**	**418**	**119**	**84**	**209**	**962**

Figure 4: Countries Represented in Computer Science Materials Cited by JASIS (1970-1985)

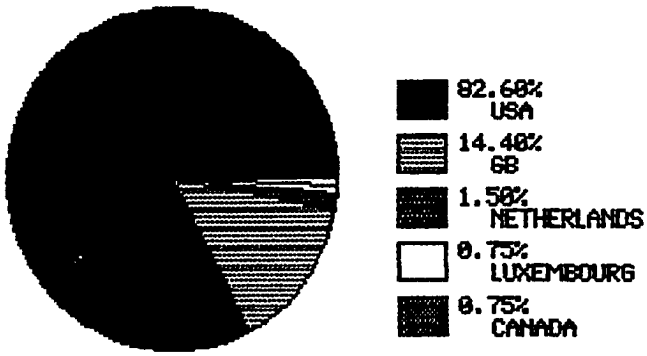


Figure 5: Countries Represented in Information Science Materials Cited by JASIS (1970-1985)

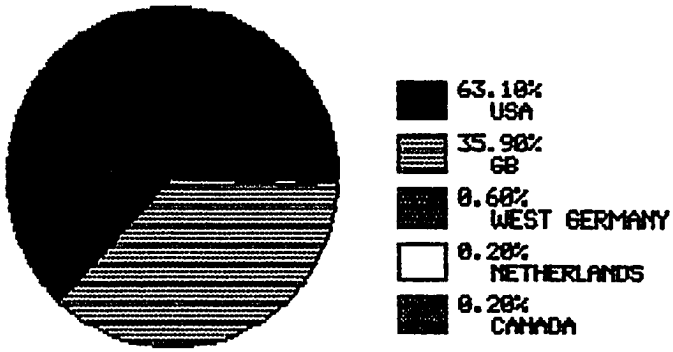


Figure 6: Countries Represented in Library Science Materials Cited by JASIS (1970-1985)

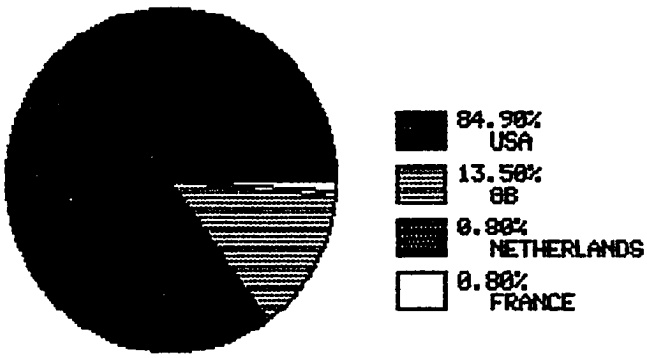
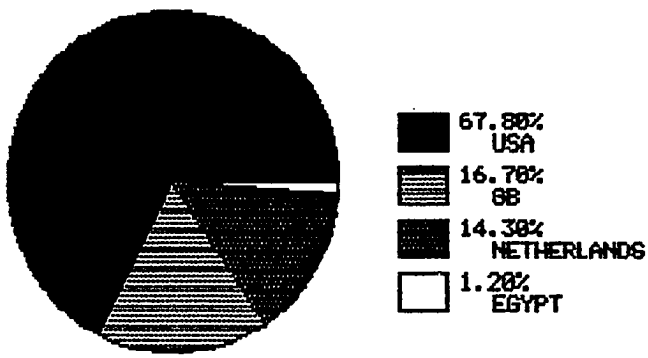


Figure 7: Countriers Represented in Science-General Materials Cited by JASIS (1970-1985)



3. Citations by journals: It was found that 226 different journals were cited by the authors of the articles published in JASIS during the period January, 1970 through December, 1985.

The list of the highly cited journals and the number of times that each journal was cited are shown in Table 4.12.

Table 4.12

Title and Number of Citations of Each Journal Cited by JASIS Articles (1970-1985)

Title	No. of Cit.	%	Rank	Cum.
JASIS	162	27.30	1	27.30
J. of Doc.	87	9.04	2	36.34
IPM(IS&R included)	61	6.34	3	42.68
Am Doc	53	5.50	4	48.18
Science	37	3.90	5	52.08
J. of the ACM	32	3.33	6	55.41
ARIST*	26	2.70	7	58.11
JCICS(JCD included)	25	2.60	8	60.71
Comm. of the ACM	18	1.90	9	62.61
College & Res. Libraries	16	1.70	10	64.31
J. of Library Automation	13	1.40	11	65.71
Nature	13	1.40	11	67.11
Scientometrics	12	1.25	13	68.36
ASLIB Proceedings	9	.94	14	69.30
Online	9	.94	14	70.24
Online Review	9	.94	14	71.18
American Psychologist	8	.83	17	72.01
Management Science	8	.83	17	72.84
Social Studies of Science	8	.83	17	73.67
All Others (209 journals)	356	26.33%		100.00%

*It was explained in the Methodology Chapter why ARIST was treated as a journal.

The titles of the journals cited by JASIS authors are presented in Appendix F. The number of journals and citations divided by disciplines are shown in Table 4.13

Table 4.13

Number of Journals and Times They Were Cited by JASIS Articles Divided by Disciplines

Discipline	No. of journals	No. of cit.
Computer Sc.	36	132
Library Sc.	33	119
Psychology	21	37
Information Sc.	18	418
Management	14	25
Science	13	84
Education	10	11
Medicine	8	9
Economics	7	11
Engineering	7	11
Linguistics	7	7
Chemistry	6	29
Sociology	5	10
Biology	4	4
Political Sc.	4	5
Pub. & Journalism	4	5
Chemical Engineering	3	8
Knowledge	3	6
Math. & Statistics	3	6
Physics	3	4
Social Sciences	3	4
Communications	2	2
General periodicals	2	4
Languages	2	3
Law	2	2
Agriculture	1	1
Botany	1	1
Commerce	1	1
Geology	1	1
Literature	1	1
Philosophy	1	1
Total	**226**	**962**

4. Age of JASIS citations: The age of citation, for the purpose of this study, means the period between the the publishing date of a book or an article in a journal and the date that book or article was cited by the JASIS author. It was found that the average age of materials that were cited by JASIS authors during the period January, 1970 through December, 1985 was seven years with a standard deviation of 6.3. However, the age of journal citations was different from the age of book citations.

The average age of book citations was found to be 9.2 years of age with a standard deviation of 9. This means that book citations were almost three years older than journal citations during the study period.

The age of journal citations that were examined averaged 6.3 years with a standard deviation of 5.6.

The average age of book citations during the first half of the 1970's (first study period) was 6.9 years. It increased to 9.2 years during the second half of the 1970's (the second study period). This average became ten years during the period January, 1980 through December, 1985.

Table 4.14 shows the average age of journal citations from the major contributors divided by the years

of the study.

Table 4.15 shows the journal citations arranged by their sources. Table 4.16 shows the average age of book citations and journal citations during the 16 years of the investigation. The diagrams that follow the tables present some of the data that is displayed in the three tables.

Table 4.14

Average Age of Journal Citations by Disciplines

Year	C.S.	I.S.	L.S.	Sc.	All
1970	6.0	4.4	1.0	2.0	7.8
1971	6.0	3.6	4.9	4.5	4.9
1972	2.0	2.9	3.5	12.0	4.2
1973	3.7	3.7	2.6	5.0	7.9
1974	7.4	3.9	8.4	6.7	5.7
70-74	**5.1**	**3.6**	**4.4**	**6.7**	**5.8**
1975	15.0	4.3	3.5	6.0	6.6
1976	7.7	5.3	4.5	6.4	6.2
1977	6.6	4.9	2.0	6.8	5.3
1978	1.8	3.9	2.8	4.7	3.9
1979	7.3	5.8	3.6	7.0	5.9
75-79	**6.9**	**4.9**	**3.9**	**6.1**	**5.7**
1980	2.8	5.3	7.6	9.2	6.6
1981	5.6	5.1	7.4	9.0	6.5
1982	2.4	8.7	8.9	8.6	8.2
1983	3.2	4.7	12.8	5.1	6.4
1984	7.1	4.5	8.4	5.8	6.8
1985	4.6	8.1	7.5	5.4	7.5
80-85	**4.7**	**6.2**	**8.6**	**7.2**	**6.9**
Grand Avg.	**5.3**	**5.2**	**5.7**	**6.8**	**6.3**

Table 4.15

Journals Cited by JASIS
Arranged by Their Average Age

Journal	No. of Cit.	Avg. Age of Cit.	S
Online	9	2.2	1.7
Scientometrics	12	2.8	1.4
Online Review	9	2.9	1.7
JASIS	162	3.7	2.9
Comm. of the ACM	18	4.4	3.9
J. of Library Automation	13	4.7	3.8
JCICS*(JCD** is included)	25	4.9	3.6
Social Studies of Science	8	5.0	2.1
Col. & Res. Libs.	16	5.2	4.6
ASLIB Proc.	9	5.3	4.3
IPM***(ISR**** is included)	61	5.5	4.4
J. of Doc.	87	5.8	4.1
ARIST	26	6.3	4.3
J. of the ACM	32	7.3	7.0
Science	37	7.4	4.4
Nature	13	7.6	4.1
Management Sc.	8	8.4	6.5
Am. Psychologist	8	8.8	5.8
Am. Doc.	53	9.2	6.5
All others	356	8.3	14.2
Total Avg.	**962**	**6.3**	**5.6**

* Journal of Chemical Information and Computer Science.

** Journal of Chemical Documentation.

*** Information Processing and Management.

**** Information Storage and Retrieval.

S: Standard Deviation.

Table 4.16

Average Age of Book, Journal, and All JASIS Citations Divided by the Sixteen Years of the Study

Year	Avg. Age of Jour. Cit.	Avg. Age of Book Cit.	Avg. Age of Cit.
1970	7.7	12.4	7.0
1971	4.9	6.7	5.6
1972	4.2	5.8	4.5
1973	7.9	6.9	7.5
1974	5.7	9.9	6.4
70-74	**5.8**	**7.9**	**6.1**
1975	6.6	14.9	8.7
1976	6.2	8.3	6.6
1977	5.3	7.0	5.4
1978	3.9	8.1	4.6
1979	5.9	7.7	6.3
75-79	**5.7**	**9.2**	**6.3**
1980	6.6	10.4	7.6
1981	6.5	11.0	7.5
1982	8.2	11.5	9.1
1983	6.4	6.8	6.5
1984	6.8	8.7	7.1
1985	7.5	9.0	7.7
80-85	**6.9**	**10.0**	**7.5**
70-85	**6.3(5.6)**	**9.2(9.0)**	**7.0(6.3)**

( ) Standard Deviation

Figure 8: Average Age of JASIS Citations (1970-1985)

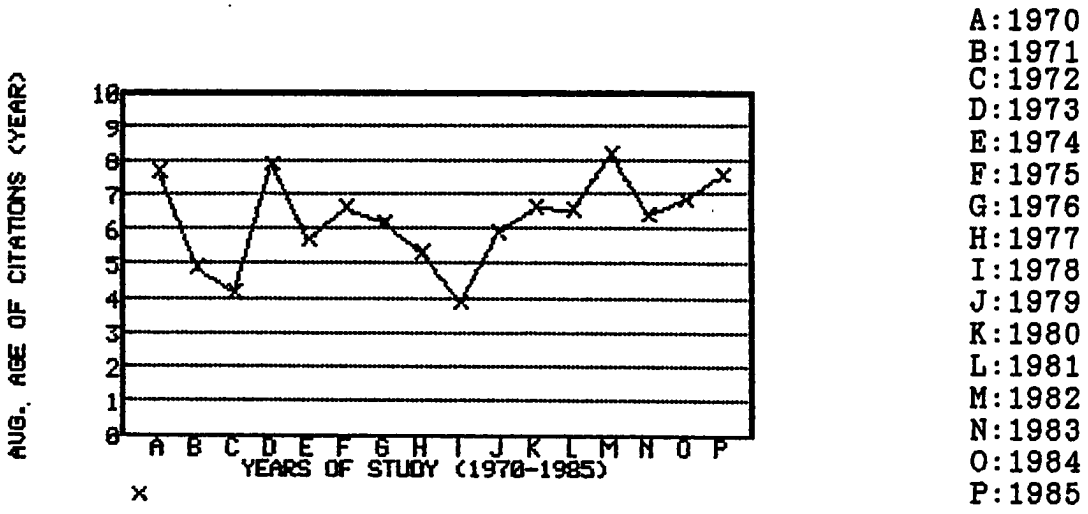


Figure 9: Average Age of Citations Contributed by Computer Science to JASIS (1970-1985)

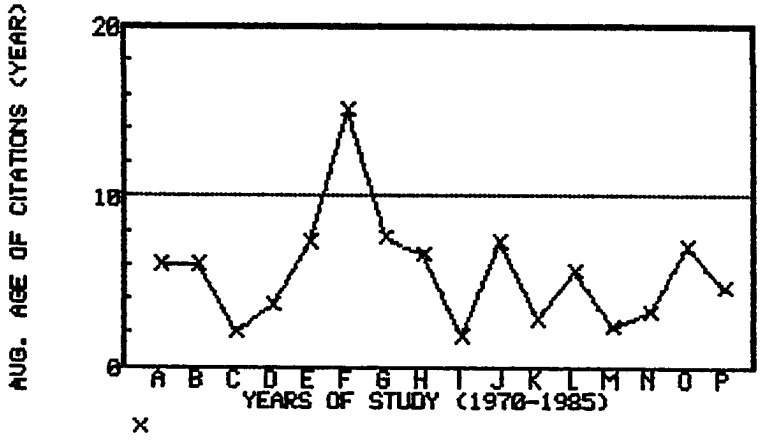


Figure 10: Average Age of Citations Contributed by Information Science to JASIS (1970-1985)

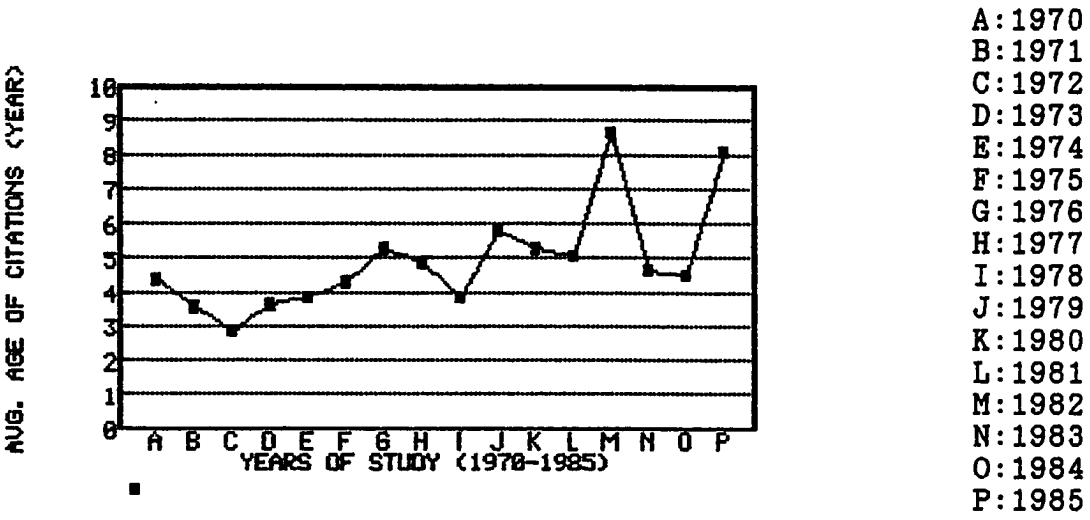


Figure 11: Average Age of Citations Contributed by Library Science to JASIS (1970-1985)

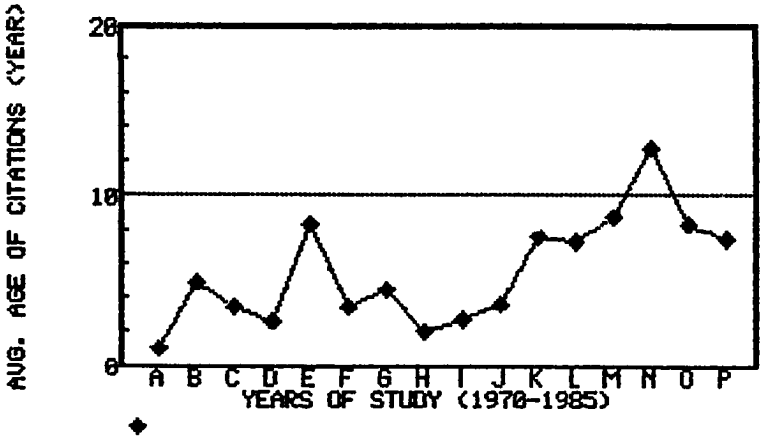
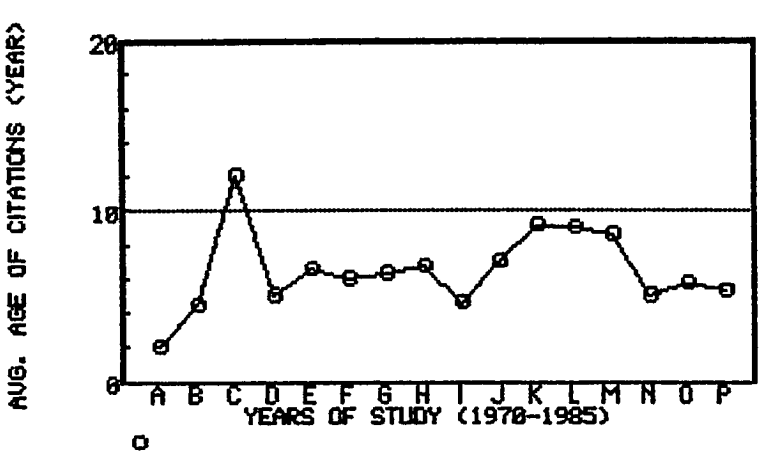


Figure 12: Average Age of Citations Contributed by Science-General to JASIS (1970-1985)



A:1970
B:1971
C:1972
D:1973
E:1974
F:1975
G:1976
H:1977
I:1978
J:1979
K:1980
L:1981
M:1982
N:1983
O:1984
P:1985

Figure 13: Average Age of JASIS Journal Citations

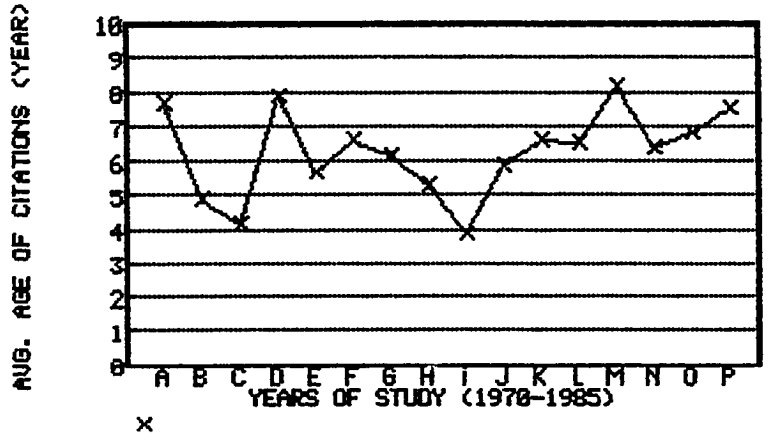


Figure 14: Average Age of JASIS Book Citation

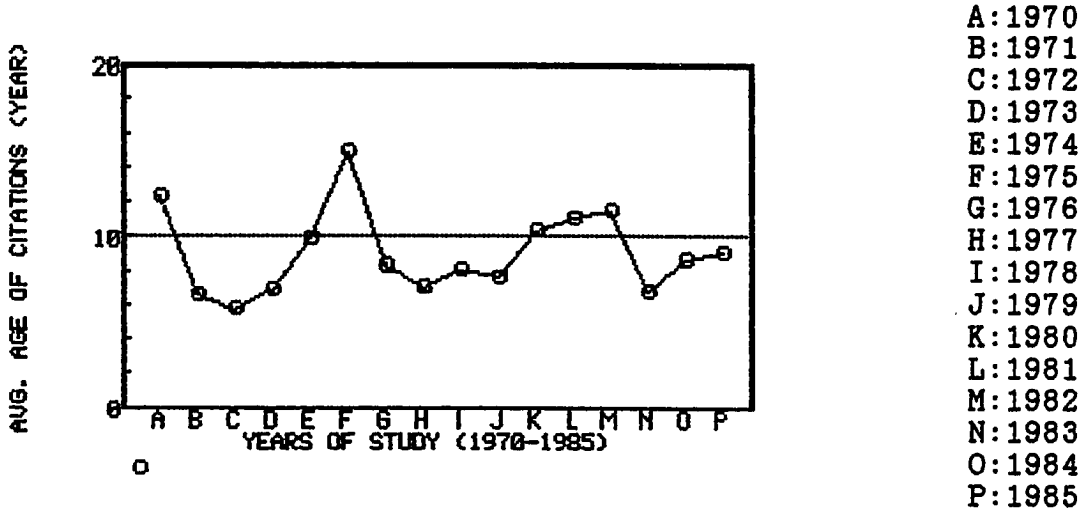
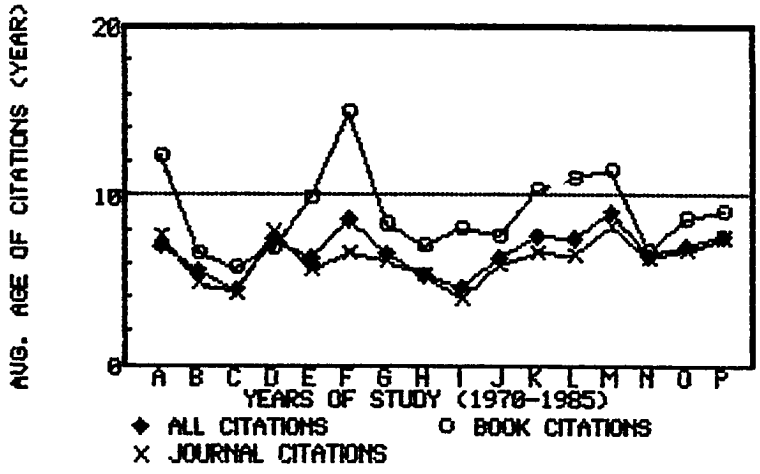


Figure 15: Average Age of Journal, Book, and All of JASIS Citations (1970-1985)



The figures in Table 4.14 show that "General science" journal citations were older than journal citations from the other three disciplines (general science citations averaged 6.8 years).

Information science journal citations were the most current (5.2 years old) followed by computer science journal citations (5.3 years of age) and library science (5.7 years of age). Another finding recognized from the figures in Table 4.14 is that information science journal citations that came from information science periodicals are getting older through the study periods.

Information science journal citations averaged 3.6 years during the first study period (January, 1970 through December, 1974). They became 4.9 years old during the second study period (January, 1975 through December, 1979). Finally, during the third study period (January, 1980 through December, 1985) these citations became 6.2 years of age.

The mid-1960's may be considered the period when information science literature started to be published in specialized information science journals.

The final finding that should be noted in this

bibliometric analysis is the age of different journals cited by the authors of the articles published in JASIS during the period January, 1970 through December, 1985.

Citations from Online, which began publication in 1977, averaged only 2.2 years old. Citations from the American Documentation were the oldest journal citations examined in this study and averaged 9.2 years. This can be accounted for by AD's cessation of publication in 1968.

CHAPTER V

SUMMARY AND CONCLUSIONS, FINDINGS, IMPLICATIONS, AND RECOMMENDATIONS FOR FUTURE STUDIES

In this chapter, the objectives, findings, applications of the study, and implications of the findings of potential value for education for information science are summarized and discussed. Conclusions based on the findings are drawn.

Suggestions for future studies for continuation of the research in this area are offered.

5.1. Summary and Conclusions

The study identifies the disciplines that contributed to the literature of information science from January, 1970 through December, 1985 as represent by the articles of the Journal of the American Society for Information Science (JASIS). The study also underlines the changes in these contributions which were assumed to

represent the change in the interdisciplinarity of information science.

The basic objectives of the study were:

1. To describe the interdisciplinarity of information science.

2. To highlight the changes in this interdisciplinarity during the 16 years that were covered by the study.

To select the source of data to be investigated, letters were sent to thirty "information experts" in which the experts were asked to select five journals that they considered to be the most representative of information science.

Twenty-five responses were received. The Journal of the American Society for Information Science (JASIS) was selected as the most representative of the literature of information science by twenty-one information experts, so it was selected to be the source of data for this study.

The population for the study included all the journals and books that were cited by JASIS articles published in the journal from the first issue carrying the current title (January, 1970) through the last issue in 1985 (December, 1985). Ninty-six issues of JASIS were examined. These ninty-six issues included 12,005

references. The population was divided into sixteen subgroups, and each subgroup includes all citations appearing in the six issues of JASIS published in one year of each of the sixteen years of the study. Ten percent of the citations in each subgroup were randomly selected to be included in the sample of the study which was to be investigated.

The final size of the sample was 1202 references.

5.2. Findings

Frequency distributions, tables and other statistical measures are used to present the data and the findings of the study. The basic purpose of this presentation is to answer the study's research questions.

The first research question is:

What are the disciplines that contributed to information science between 1970 and 1985?

The sample that was drawn and the data that were examined provided a list of thirty-two disciplines as the contributors to information science during the study period. Table 5.1 shows these disciplines and the percentages of their contributions.

If the contributors to information science, except information science itself, were arranged by their traditional academic affiliation, the schools and colleges are shown in Table 5.2 host these contributors.

If the Colleges of Arts and Science are further divided into the three traditional areas of Science/ Technology, Social Sciences, and Humanities, the contributions of fields affiliated with each college are shown in Table 5.3.

TABLE 5.1

The Contributors To Information Science
1970-1985

DISCIPLINE	% OF CITATIONS	RANK	Cum. %
Information Science	41.76%	1	41.76%
Computer science	12.81%	2	54.57%
Library Science	12.20%	3	66.77%
Science-General	9.00%	4	75.77%
Psychology	3.74%	5	79.51%
Management	3.07%	6	82.58%
Chemistry	2.68%	7	85.26%
Mathematics & Statistics	2.07%	8	87.33%
Sociology	1.41%	9	88.74%
Economics	1.28%	10	90.02%
Education	1.08%	11	91.10%
Knowledge	1.08%	11	92.18%
Engineering*	1.00%	13	93.18%
Medical Science	.80%	14	93.98%
Communication	.75%	15	94.73%
Linguistics	.75%	15	95.48%
Chemical Engineering	.65%	17	96.13%
Languages (DDC 400)	.50%	18	96.63%
Law	.50%	18	97.13%
Political Science	.50%	18	97.63%
Biology	.42%	21	98.05%
Publishing	.42%	21	98.47%
Social sciences	.42%	21	98.89%
General works	.31%	24	99.20%
Physics	.31%	24	99.51%
Agriculture	.07%	26	99.58%
Botany	.07%	26	99.65%
Commerce	.07%	26	99.72%
Geology	.07%	26	99.79%
Literature	.07%	26	99.86%
Philosophy	.07%	26	99.93%
Photography	.07%	26	100.00%
Total	100.00%		

*Chemical Engineering is not included.

Table 5.2

Contributors to Information Science
According to their Academic Affiliations

College or School	Number of Citations	%	RANK
Colleges of Arts & Sciences	439	64.00	1
Library Schools	147	21.00	2
Business Schools	38	5.50	3
Engineering Schools	20	2.90	
Colleges of Communication	15	2.00	4
Education Schools	13	1.90	5
Medical Schools	10	1.45	6
Law Schools	6	.90	7

Table 5.3

The Arts and Sciences Contributors
by Their Specialties

College	No. of Citations	%
Sciences/Technology	330	48.00%
Humanities	66	9.60%
Social Sciences	43	6.25%

Another finding in this regard was that a large number of disciplines have contributed to information science. However, this finding was expected based on the results of other studies (Afsharpanah, 1983).

The second research question is:

How did the contributions of different disciplines to information science change between 1970 through 1985?

The inside citations (contribution of information science to itself) did not change markedly during the study periods. However, a slight decrease in the inside contributions could be detected.

During the first study period, 43.81% of information science references came from information science. This percentage becomes 46.35% if JCD & JCICS are classified as information science journals rather than chemistry. The information science contribution decreased to 41.64% during the second study period and decreased again to 40.6% during the third study period.

Citations from computer science increased from 6.02% of the total during the first half of the 1970's (nineteen citations) to 11.35% (thirty-six citations) in the second half of that decade. In the first half of the 1980's, 17.43% (ninty-nine citations) of information science citations came from computer science. The contribution of computer science to information science

has increased by almost 200% between the first half of the 1970's and the first half of the 1980's.

The percentages of information science citations that came from computer science in the last three years of the study (1983, 1984, and 1985) were 19.42%, 19.5%, and 20.4% respectively.

The change in the contribution of library science was as marked as the change in computer science contribution. During the first period of the study (January, 1970 through December, 1974), 14.3% (45 citations) of JASIS citations came from library science literature. This number increased to 15.13% (48 citations) during the period January, 1975 through December, 1979 (the second study period). But this contribution decreased to only 9.4% (54 citations) of JASIS citations during the third study period (January, 1980 through December, 1985).

In the last three years of the study, the contribution of library science to information science was:

1983	6 citations	5.83% of total
1984	6 citations	7.8% of total
1985	4 citations	3.9% of total

The decreased contribution of library science could

be considered as a sign of a weakening relationship between library science and information science.

It is beyond the study's concern to provide reasons for the decreasing or increasing contribution of any discipline to information science. The study's only concern is to report and to highlight these observations. However, the decreased number of library science books and articles cited by information science authors is evidence that fewer library science related topics were discussed and investigated by information science authors in the early 1980's.

The contribution of general science (DDC 500-509) is changed during the sixteen years of the study. During the first period (1970-1974), 5.71% of information science citations come from journal articles or books classified as "Science". This number increased to 10.72% in the second period (1975-1979). But it decreased slightly to 9.84% in the third period (1980-1985).

Relative changes in the contributions of other disciplines were detected. Appendix B provides information about the changes of the contributions through the entire period of study.

The third research question is:

Which disciplines are the major contributors to the information science literature in the periods 1970-1974, 1975-1979 and 1980-1985?

The first problem in answering this question was to determine what was meant by "major contributors". To solve this problem, the researcher defines "major contributors" as the eight disciplines with the highest contributions during the study period.

Major contributors were found to be: information science, computer science, library science, science in general, psychology, management, chemistry, and mathematics and statistics.

The four highest contributors during each period were: information science, library science, computer science, and science in general.

Information science was the first contributor during each one of the three study periods. The information science contribution was always more than 40% of total contribution during each period.

Computer science was the third highest contributor to the interdisciplinarity of information science during the first and second periods (1970-1974 and 1975-1979),

but it became the second highest contributor during the third period (1980-1985) and ended as the second highest contributor during the sixteen years of study.

Library science was the second highest contributor to the information science literature during the first two periods of the study. During the third period, however, library science became the fourth highest contributor. In total, library science was the third highest contributor during the sixteen years of examination.

Science in general (DDC 500-509) was the fourth highest contributor during the first and second periods of the study. It became the third highest contributor during the third period, and it finished as the fourth highest contributor for the entire study period.

Psychology, management, chemistry, and mathematics and statistics shared the next four positions and they exchanged positions from one period to another.

The major finding in this regard is the changing of positions of library science and computer science during the sixteen years of study. The results of the analysis of the data indicate that the contribution of library

science to information science was decreasing during the 1980's. On the other hand, the contribution of computer science was markedly increasing during the same period.

These findings lead to the conclusions that:

1. Fewer library science related topics were covered by information science literature and authors in the 1980's. This finding is based on the fact that the number of library science materials which were cited by the authors of information science articles that were published in JASIS during the period January, 1970 through December, 1985 decreased markedly during the third period of study (January, 1980 through December, 1985).

2. More computer science related topics were cited by information science literature and authors in the 1980's. This finding is based on the fact that the number of computer science citations has increased during the sixteen years of the study.

3. Although it is difficult to map the educational backgrounds of the information science authors based on the data that were analyzed in this study, it seems that the information science authors of the 1980's have more computer science and technology backgrounds than library science backgrounds. This finding is based on the sources of materials that were cited by these authors which became more computer science related during the second half of the 1970's and first half of the 1980's.

4. Finally, based on 1-3 above, it is obvious that the relationship between information science and library science was weakening during the first half of the 1980's. The relationship between information science and computer science becomes stronger during the same period.

5.3. Another Academic Affiliation?

Based on the findings of this study which indicate that library science was contributing less to the inter-disciplinarity of information science; it may be possible to conclude that the relationship between library science and information science is weakening; and it might continue the declination. This may lead information scientists to question the validity of the current academic affiliation of a large number of information science educational programs as part of the educational programs offered by library schools and in most cases not separated from the library science program (MLS or Ph.D. in Library and Information Science/Studies).

The academic affiliation of information science with other disciplines, such as computer science as at Cornell University, Georgia Institute of Technology, The Ohio State University, and many other institutions, may also be questioned regardless of the relative increase of the contributions of the other disciplines to information science during the sixteen years of study. The findings of this study indicate that information science, itself,

is the major contributor of references cited by the authors of information science articles. Few other disciplines, such as computer science, library science and science in general, contributed greatly to information science, but not to the extent of information science itself. In total, the second highest contributor (computer science) contributed only 12.81% of the total citations examined in this study. Information science contributed 41.76% of all the examined citations.

The great differences between the contribution of information science and the contributions of all other disciplines to the literature of information science make it valid to question all other academic affiliations of information science with any other departments, colleges, and schools.

Based on these facts, associated with the lack of a standardized information science program at any educational level; "the rapid and rather chaotic evolution of information science [that] left the fields academic sector in a largely disorganized state"[209]; and, since "it is clear that academic programs will play a critical role in shaping information science's future as a field of professional activity and as an area of

scientific inquiry"[210]; it may become necessary to investigate the possibility of a new academic affiliation for the information science educational programs in the hope that this affiliation will help the field to develop and create better and more organized educational programs.

5.4. Implications of the findings

One finding of this study indicates that information science itself was the highest contributor of citations to its literature during the period 1970-1985.

This finding may provide evidence to support the argument that information science is an independent discipline with many strong relationships with other disciplines like computer science and library science rather than being a subfield of any other discipline as many think.

A second finding, which could have an important influence on the future of information science, is the decreasing number of library science materials cited by the authors of the information science articles examined in the study. This finding, associated with the third

finding indicate that citations from computer science have markedly increased during the same period, could be used as a starting point in an inquiring the validity of the current status of many information science educational programs which are currently programs within library and information science or computer and information science educational programs. However, further investigations and studies are needed to outline the requirements of such programs and their academic affiliation.

The identification of the subject structure of information science, the evolution of this structure, and the characteristics of its interdisciplinarity may help in solving the problem of the curriculum design and development of information science educational programs.

The bibliometric findings of the study may help librarians in schools, colleges, and departments that host the information science educational programs to select some of the periodicals that are important to the field based on the number of citations these periodicals contributed to information science literature. Most of these periodicals were not classified as information

science journals (only eighteen out of two hundred and twenty-six cited journals were considered to be information science journals).

5.5. Recommendations for Future Studies

In consideration of the findings of the study, a need for additional research seems essential to provide more clarifications of the interdisciplinarity and structure of information science. The following studies are recommended.

1. A bibliometric study of other sources of data (other journals in information science) may be conducted. The findings of these studies may be compared with the findings of this study and Afsharpanah's study. The journals suggested (based on the opinions of the information expert) are: Information Processing and Management, Journal of Documentation and Journal of Information Science.

2. A consideration of other issues that may have influenced the changing structure of information science is recommended. These issues include: the educational backgrounds of the authors of information science

articles and their academic affiliations, the work places of the authors of information science articles, etc.

3. The influence of new information technologies, such as computers and microcomputers on the topics to be covered under the term "information science" is another important issue to be investigated. These topics may be reflected in the interdisciplinarity of information science.

4. A study to design a standardized information science educational program(s) is necessary to outline what to be included in such programs.

5. A study to investigate the academic affiliation of information science educational programs is very important for the development of the field.

6. A parallel study that investigate a library science major journal to highlight the evolution of the contribution of information science to library science is important to provide more information to underline the evolution of the relationship of library science and information science.

7. A explicit examination of the degree to which

the distributions observed in this study are normal, or not normal is recommended.

Finally, if another researcher chose to follow an investigation technique similar to the one followed in this study for further studies, three important issues may be taken into account:

1. Many problems occurred in this study because DDC was used as a classification system. The usage of another classification system or technique is strongly recommended.

2. Individual articles in interdisciplinary journals (e.g., Science, Nature, Scientific America, etc.), classified by the this study in Science-General and Social Sciences-General, be classified according to their subject matters.

3. Growth of the literature in the field generally, and specifically of the title to be examined, be taken into account to see if this might have any effect.

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APPENDICES

Appendix A

A letter to information experts to select the source of data to the study

IMAD A.AL-SABBAGH
FSU BOX 4114
TALLAHASSEE, FL 32313

Dear .....

I am a Ph.D. Candidate at the Florida State University studying the evolution of the inter-disciplinarity of information science through its literature.

My study is an investigation of a major journal in the field that may represent the field of information science. In this aspect, I need the help of experts in information science, like yourself, to select the source of data for the study.

Would you, please, help me by listing the five journals you think that represent information science the most. I will assume that your first selection would be the most representative. The second is the second important and so on.

I would like very much to thank you for taking time to help me in my research.

Sincerely Yours,

Imad A. Al-Sabbagh

APPENDIX B
TOTAL CONTRIBUTIONS OF DIFFERENT DISCIPLINES TO INFORMATION SCIENCE FOR THE PERIOD 1970 THROUGH 1985

TOTAL

YEAR: 1970

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	14	36.90	1
Computer Science	2	5.20	5
Knowledge			
Library Science	2	5.20	5
General			
Journalism & Publishing	1	2.60	7
Philosophy			
Psychology	1	2.60	7
Social Science			
Sociology			
Political Science			
Economics			
Law			
Education			
Commerce			
Language (General)			
Linguistics			
Science (General)	5	13.20	2
Mathematics and Statistics	3	8.00	4
Physics			
Chemistry	5	13.30	2
Geology			
Biology	1	2.60	7
Botany	1	2.60	7
Medical Sciences	1	2.60	7
Engineering (except Chemical Eng.)			
Agriculture			
Management	1	2.60	7
Chemical Engineering	1	2.60	7
Literature Communication			
Photography			

TOTAL

YEAR: 1971

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	24	39.00	1
Computer Science	2	3.20	5
Knowledge	2	3.20	5
Library Science	13	21.00	2
General	2	3.20	5
Journalism & Publishing		1.60	12
Philosophy			
Psychology	3	4.80	3
Social Science			
Sociology	2	3.20	5
Political Science	2	3.20	5
Economics	1	1.60	12
Law			
Education	1	1.60	12
Commerce			
Language (General)			
Linguistics			
Science (General)	3	4.80	3
Mathematics and Statistics	2	3.20	5
Physics			
Chemistry	1	1.60	12
Geology			
Biology			
Botany			
Medical Sciences			
Engineering (except Chemical Eng.)			
Agriculture			
Management	1	1.60	12
Chemical Engineering			
Literature			
Communication	2	3.20	5
Photography			

TOTAL

YEAR: 1972

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	35	45.50	1
Computer Science	5	6.50	3
Knowledge	2	2.60	6
Library Science	16	20.80	2
General	1	1.30	9
Journalism & Publishing			
Philosophy			
Psychology	1	1.30	9
Social Science			
Sociology			
Political Science	1	1.30	9
Economics	2	2.60	6
Law			
Education			
Commerce			
Language (General)			
Linguistics			
Science (General)	3	3.90	5
Mathematics and Statistics			
Physics	1	1.30	9
Chemistry	1	1.30	9
Geology			
Biology			
Botany			
Medical Sciences	1	1.30	9
Engineering (except Chemical Eng.)	1	1.30	9
Agriculture	1	1.30	9
Management	4	5.20	4
Chemical Engineering	2	2.60	6
Literature			
Communication			
Photography			

TOTAL

YEAR: 1973

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	27	41.50	1
Computer Science	4	6.13	4
Knowledge			
Library Science	9	13.83	2
General			
Journalism & Publishing			
Philosophy			
Psychology	7	10.70	3
Social Science			
Sociology	2	3.10	7
Political Science			
Economics	1	1.55	10
Law			
Education	2	3.10	7
Commerce			
Language (General)	1	1.55	10
Linguistics	1	1.55	10
Science (General)	3	4.65	5
Mathematics and Statistics	3	4.65	5
Physics			
Chemistry	1	1.55	10
Geology			
Biology	1	1.55	10
Botany			
Medical Sciences	1	1.55	10
Engineering (except Chemical Eng.)			
Agriculture			
Management	2	3.10	7
Chemical Engineering			
Literature			
Communication			
Photography			

TOTAL

YEAR: 1974

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	39	52.70	1
Computer Science	6	8.12	2
Knowledge			
Library Science	5	6.80	3
General	1	1.34	10
Journalism & Publishing	1	1.34	10
Philosophy			
Psychology	3	4.00	6
Social Science			
Sociology			
Political Science	2	2.68	7
Economics			
Law	1	1.34	10
Education			
Commerce			
Language (General)	2	2.68	7
Linguistics	2	2.68	7
Science (General)	4	5.40	4
Mathematics and Statistics			
Physics	1	1.34	10
Chemistry	4	5.40	4
Geology			
Biology			
Botany			
Medical Sciences			
Engineering (except Chemical Eng.)	1	1.34	10
Agriculture			
Management			
Chemical Engineering	1	1.34	10
Literature	1	1.34	10
Communication			
Photography			

TOTAL

YEAR: Period I, 1970-1974

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	139	43.80	1
Computer Science	19	6.02	3
Knowledge	4	1.27	10
Library Science	45	14.28	2
General	4	1.27	10
Journalism & Publishing	3	.95	15
Philosophy			
Psychology	15	4.76	5
Social Science			
Sociology	4	1.27	10
Political Science	5	1.60	9
Economics	4	1.27	10
Law	1	.32	23
Education	3	.95	15
Commerce			
Language (General)	3	.95	15
Linguistics	3	.95	15
Science (General)	18	5.71	4
Mathematics and Statistics	8	2.54	7
Physics	1	.32	23
Chemistry	12	3.81	6
Geology	1	.32	23
Biology	2	.64	20
Botany	1	.32	23
Medical Sciences	3	.95	15
Engineering (except Chemical Eng.)	2	.64	20
Agriculture	1	.32	23
Management	8	2.54	7
Chemical Engineering	4	1.27	10
Literature	1	.32	23
Communication	2	.64	20
Photography			

TOTAL

YEAR: 1975

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	23	41.10	1
Computer Science	2	3.58	6
Knowledge			
Library Science	8	14.30	2
General			
Journalism & Publishing	1	1.78	9
Philosophy			
Psychology	3	5.36	4
Social Science	1	1.78	9
Sociology	1	1.78	9
Political Science			
Economics			
Law	1	1.78	9
Education	2	3.58	6
Commerce			
Language (General)	1	1.78	9
Linguistics			
Science (General)	6	10.70	3
Mathematics and Statistics			
Physics			
Chemistry	1	1.78	9
Geology			
Biology	1	1.78	9
Botany			
Medical Sciences	2	3.58	6
Engineering (except Chemical Eng.)			
Agriculture			
Management	3	5.34	4
Chemical Engineering			
Literature			
Communication			
Photography			

TOTAL

YEAR: 1976

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	33	42.30	1
Computer Science	13	16.67	2
Knowledge	2	2.55	6
Library Science	6	7.70	5
General			
Journalism & Publishing			
Philosophy	1	1.28	7
Psychology			
Social Science			
Sociology			
Political Science			
Economics			
Law			
Education	1	1.28	7
Commerce			
Language (General)	1	1.28	7
Linguistics	1	1.28	7
Science (General)	9	11.54	3
Mathematics and Statistics	1	1.28	7
Physics			
Chemistry	7	9.00	4
Geology			
Biology			
Botany			
Medical Sciences	1	1.28	7
Engineering (except Chemical Eng.)	1	1.28	7
Agriculture			
Management			
Chemical Engineering			
Literature			
Communication	1	1.28	7
Photography			

TOTAL

YEAR: 1977

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	17	27.87	1
Computer Science	7	11.48	3
Knowledge			
Library Science	16	26.23	2
General			
Journalism & Publishing			
Philosophy			
Psychology	1	1.64	10
Social Science			
Sociology	2	3.28	7
Political Science	1	1.64	10
Economics	2	3.28	7
Law			
Education			
Commerce	1	1.64	10
Language (General)			
Linguistics	1	1.64	10
Science (General)	5	8.20	4
Mathematics and Statistics	2	3.28	7
Physics			
Chemistry	3	4.91	5
Geology			
Biology			
Botany			
Medical Sciences			
Engineering (except Chemical Eng.)			
Agriculture			
Management	3	4.91	5
Chemical Engineering			
Literature			
Communication			
Photography			

TOTAL

YEAR: 1978

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	25	42.36	1
Computer Science	5	8.47	4
Knowledge			
Library Science	10	16.95	2
General			
Journalism & Publishing			
Philosophy			
Psychology	1	1.70	7
Social Science			
Sociology			
Political Science			
Economics			
Law			
Education			
Commerce			
Language (General)			
Linguistics	2	3.38	6
Science (General)	8	13.56	3
Mathematics and Statistics			
Physics	1	1.70	7
Chemistry	1	1.70	7
Geology			
Biology			
Botany			
Medical Sciences			
Engineering (except Chemical Eng.)	1	1.70	7
Agriculture			
Management	4	6.78	5
Chemical Engineering	1	1.70	7
Literature			
Communication			
Photography			

TOTAL

YEAR: 1979

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	34	53.97	1
Computer Science	9	14.29	2
Knowledge			
Library Science	8	12.70	3
General			
Journalism & Publishing			
Philosophy			
Psychology			
Social Science			
Sociology			
Political Science			
Economics	1	1.59	6
Law			
Education	1	1.59	6
Commerce			
Language (General)			
Linguistics			
Science (General)	6	9.52	4
Mathematics and Statistics			
Physics			
Chemistry			
Geology			
Biology			
Botany			
Medical Sciences			
Engineering (except Chemical Eng.)			
Agriculture			
Management	3	4.75	5
Chemical Engineering			
Literature			
Communication	1	1.59	6
Photography			

TOTAL

YEAR: Period II, 1975-1979

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	132	41.63	1
Computer Science	36	11.35	3
Knowledge	2	.62	14
Library Science	48	15.13	2
General			
Journalism & Publishing	1	.32	19
Philosophy	1	.32	19
Psychology	5	1.57	7
Social Science	1	.32	19
Sociology	3	.95	10
Political Science	1	.32	19
Economics	3	.95	10
Law	1	.32	19
Education	4	1.26	14
Commerce	1	.32	19
Language (General)	2	.63	14
Linguistics	4	1.26	8
Science (General)	34	10.72	4
Mathematics and Statistics	3	.95	10
Physics	1	.32	19
Chemistry	12	3.79	6
Geology			
Biology	1	.32	19
Botany			
Medical Sciences	3	.95	10
Engineering (except Chemical Eng.)	2	.63	14
Agriculture			
Management	13	4.1	5
Chemical Engineering	1	.32	19
Literature			
Communication	2	.63	14
Photography			

TOTAL

YEAR: 1980

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	32	40.50	1
Computer Science	10	12.65	3
Knowledge	2	2.53	6
Library Science	17	21.50	2
General			
Journalism & Publishing			
Philosophy			
Psychology	2	2.53	6
Social Science			
Sociology	1	1.27	8
Political Science			
Economics	1	1.27	8
Law			
Education			
Commerce			
Language (General)	1	1.27	8
Linguistics			
Science (General)	5	6.33	4
Mathematics and Statistics	1	1.27	8
Physics	1	1.27	8
Chemistry	3	3.80	5
Geology			
Biology	1	1.27	8
Botany			
Medical Sciences			
Engineering (except Chemical Eng.)			
Agriculture			
Management			
Chemical Engineering	1	1.27	8
Literature			
Communication			
Photography	1	1.27	8

TOTAL

YEAR: 1981

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	43	35.25	1
Computer Science	24	19.76	2
Knowledge	1	.82	11
Library Science	9	7.35	4
General	1	.82	11
Journalism & Publishing			
Philosophy			
Psychology	8	6.56	5
Social Science	1	.82	11
Sociology	1	.82	11
Political Science			
Economics	2	1.64	8
Law			
Education	1	.82	11
Commerce			
Language (General)			
Linguistics			
Science (General)	14	11.48	3
Mathematics and Statistics	6	4.92	6
Physics			
Chemistry	1	.82	11
Geology			
Biology			
Botany			
Medical Sciences	1	.82	11
Engineering (except Chemical Eng.)	2	1.64	8
Agriculture			
Management	2	1.64	8
Chemical Engineering	1	.82	11
Literature			
Communication	4	3.20	7
Photography			

TOTAL

YEAR: 1982

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	40	47.06	1
Computer Science	9	10.59	3
Knowledge	3	3.53	5
Library Science	12	14.11	2
General			
Journalism & Publishing			
Philosophy			
Psychology	2	2.35	7
Social Science			
Sociology	1	1.18	10
Political Science			
Economics	3	3.53	5
Law			
Education			
Commerce			
Language (General)			
Linguistics			
Science (General)	9	10.59	3
Mathematics and Statistics			
Physics			
Chemistry	2	2.35	7
Geology			
Biology			
Botany			
Medical Sciences			
Engineering (except Chemical Eng.)	2	2.35	7
Agriculture			
Management	1	1.18	10
Chemical Engineering			
Literature			
Communication	1	1.18	10
Photography			

TOTAL

YEAR: 1983

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	44	42.72	1
Computer Science	20	19.42	2
Knowledge	1	.97	10
Library Science	6	5.83	4
General			
Journalism & Publishing			
Philosophy			
Psychology	3	2.91	6
Social Science	2	1.94	8
Sociology			
Political Science			
Economics	1	.97	10
Law			
Education	2	1.94	8
Commerce			
Language (General)			
Linguistics	1	.97	10
Science (General)	9	8.74	3
Mathematics and Statistics	1	.97	10
Physics	1	.97	10
Chemistry	1	.97	10
Geology			
Biology	1	.97	10
Botany			
Medical Sciences	1	.97	10
Engineering (except Chemical Eng.)	3	2.91	6
Agriculture			
Management	6	5.83	4
Chemical Engineering			
Literature			
Communication			
Photography			

TOTAL

YEAR: 1984

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	25	32.47	1
Computer Science	15	19.50	2
Knowledge			
Library Science	6	7.80	4
General			
Journalism & Publishing			
Philosophy			
Psychology	4	5.20	5
Social Science	1	1.30	8
Sociology	4	5.20	5
Political Science			
Economics	1	1.30	8
Law			
Education			
Commerce			
Language (General)			
Linguistics	1	1.30	8
Science (General)	13	16.83	3
Mathematics and Statistics	4	5.20	5
Physics			
Chemistry			
Geology			
Biology			
Botany			
Medical Sciences	1	1.30	8
Engineering (except Chemical Eng.)	1	1.30	8
Agriculture			
Management	1	1.30	8
Chemical Engineering			
Literature			
Communication			
Photography			

TOTAL

YEAR: 1985

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	47	45.70	1
Computer Science	21	20.40	2
Knowledge			
Library Science	4	3.90	
General			
Journalism & Publishing	1	.97	11
Philosophy			
Psychology	6	5.83	3
Social Science			
Sociology	3	2.91	7
Political Science			
Economics			
Law	1	.97	11
Education	3	2.91	7
Commerce			
Language (General)			
Linguistics			
Science (General)	6	5.83	3
Mathematics and Statistics	2	1.94	9
Physics			
Chemistry	2	1.94	9
Geology			
Biology			
Botany			
Medical Sciences	1	.97	11
Engineering (except Chemical Eng.)			
Agriculture			
Management	5	5.00	5
Chemical Engineering	1	.97	11
Literature			
Communication			
Photography			

TOTAL

YEAR: Period III, 1980-1985

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	231	40.60	1
Computer Science	99	17.43	2
Knowledge	7	1.22	12
Library Science	54	9.40	4
General	1	.18	21
Journalism & Publishing	1	.18	21
Philosophy			
Psychology	25	4.40	5
Social Science	4	.70	15
Sociology	10	1.76	8
Political Science			
Economics	8	1.40	10
Law	1	.18	21
Education	6	1.06	13
Commerce			
Language (General)	1	.18	21
Linguistics	2	.36	17
Science (General)	56	9.84	3
Mathematics and Statistics	14	2.46	7
Physics	2	.36	17
Chemistry	9	1.58	9
Geology			
Biology	2	.36	17
Botany			
Medical Sciences	4	.70	15
Engineering (except Chemical Eng.)	8	1.40	10
Agriculture			
Management	16	2.81	6
Chemical Engineering	2	.36	17
Literature			
Communication	5	.88	14
Photography	1	.18	21

APPENDIX C

BOOK CITATIONS PUBLISHED IN JASIS FROM 1970 THROUGH 1985

BOOKS

YEAR: 1970

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	3	23.00	2
Computer Science	1	7.70	4
Knowledge			
Library Science	1	7.70	4
General			
Journalism & Publishing			
Philosophy			
Psychology			
Social Science			
Sociology			
Political Science			
Economics			
Law			
Education			
Commerce			
Language (General)			
Linguistics			
Science (General)	4	31.00	1
Mathematics and Statistics	3	23.00	2
Physics			
Chemistry	1	7.70	4
Geology			
Biology			
Botany			
Medical Sciences			
Engineering (except Chemical Eng.)			
Agriculture			
Management			
Chemical Engineering			
Literature			
Communication			
Photography			

BOOKS

YEAR: 1971

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	10	43.50	1
Computer Science			
Knowledge			
Library Science	4	17.40	2
General	1	4.34	4
Journalism & Publishing			
Philosophy			
Psychology	1	4.34	4
Social Science			
Sociology	2	8.70	3
Political Science			
Economics	1	4.34	4
Law			
Education			
Commerce			
Language (General)			
Linguistics			
Science (General)	1	4.34	4
Mathematics and Statistics			
Physics			
Chemistry			
Geology			
Biology			
Botany			
Medical Sciences			
Engineering (except Chemical Eng.)			
Agriculture			
Management	1	4.34	4
Chemical Engineering			
Literature			
Communication	2	8.70	3
Photography			

BOOKS

YEAR: 1972

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	5	33.40	1
Computer Science	1	6.60	5
Knowledge	2	13.30	3
Library Science	4	26.60	2
General			
Journalism & Publishing			
Philosophy			
Psychology			
Social Science			
Sociology			
Political Science			
Economics			
Law			
Education			
Commerce			
Language (General)			
Linguistics			
Science (General)	1	6.70	5
Mathematics and Statistics			
Physics			
Chemistry			
Geology			
Biology			
Botany			
Medical Sciences			
Engineering (except Chemical Eng.)			
Agriculture			
Management	2	13.30	3
Chemical Engineering			
Literature			
Communication			
Photography			

BOOKS

YEAR: 1973

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	10	41.70	1
Computer Science	1	4.16	5
Knowledge			
Library Science	4	16.70	2
General			
Journalism & Publishing			
Philosophy			
Psychology	1	4.16	5
Social Science			
Sociology			
Political Science			
Economics			
Law			
Education			
Commerce			
Language (General)	1	4.16	5
Linguistics	1	4.16	5
Science (General)	2	8.30	4
Mathematics and Statistics	3	12.50	3
Physics			
Chemistry			
Geology			
Biology	1	4.16	5
Botany			
Medical Sciences			
Engineering (except Chemical Eng.)			
Agriculture			
Management			
Chemical Engineering			
Literature			
Communication			
Photography			

BOOKS

YEAR: 1974

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	7	58.30	1
Computer Science	1	8.40	3
Knowledge			
Library Science			
General			
Journalism & Publishing			
Philosophy			
Psychology	2	16.70	2
Social Science			
Sociology			
Political Science			
Economics			
Law			
Education			
Commerce			
Language (General)			
Linguistics			
Science (General)	1	8.40	3
Mathematics and Statistics			
Physics			
Chemistry	1	8.40	3
Geology			
Biology			
Botany			
Medical Sciences			
Engineering (except Chemical Eng.)			
Agriculture			
Management			
Chemical Engineering			
Literature			
Communication			
Photography			

BOOKS

YEAR: Period I, 1970-1974

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	35	40.25	1
Computer Science	4	4.60	5
Knowledge	2	2.30	8
Library Science	13	14.90	2
General	1	1.15	12
Journalism & Publishing			
Philosophy			
Psychology	4	4.60	5
Social Science			
Sociology	2	2.30	8
Political Science			
Economics	1	1.15	12
Law			
Education			
Commerce			
Language (General)	1	1.15	12
Linguistics	1	1.15	12
Science (General)	9	10.35	3
Mathematics and Statistics	6	6.90	4
Physics			
Chemistry	2	2.30	8
Geology			
Biology	1	1.15	12
Botany			
Medical Sciences			
Engineering (except Chemical Eng.)			
Agriculture			
Management	3	3.45	7
Chemical Engineering			
Literature			
Communication	2	2.30	8
Photography			

BOOKS

YEAR: 1975

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	1	11.11	2
Computer Science			
Knowledge			
Library Science			
General			
Journalism & Publishing			
Philosophy			
Psychology	1	11.11	2
Social Science	1	11.11	2
Sociology			
Political Science			
Economics			
Law	1	11.11	2
Education			
Commerce			
Language (General)	1	11.11	2
Linguistics			
Science (General)	1	11.11	2
Mathematics and Statistics			
Physics			
Chemistry			
Geology			
Biology			
Botany			
Medical Sciences			
Engineering (except Chemical Eng.)			
Agriculture			
Management	2	22.22	1
Chemical Engineering			
Literature			
Communication			
Photography			

BOOKS

YEAR: 1976

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	2	25.00	2
Computer Science			
Knowledge			
Library Science			
General			
Journalism & Publishing			
Philosophy			
Psychology			
Social Science			
Sociology			
Political Science			
Economics			
Law			
Education			
Commerce			
Language (General)			
Linguistics			
Science (General)	4	50.00	1
Mathematics and Statistics			
Physics			
Chemistry			
Geology			
Biology			
Botany			
Medical Sciences	1	12.50	3
Engineering (except Chemical Eng.)			
Agriculture			
Management			
Chemical Engineering			
Literature			
Communication	1	12.50	3
Photography			

BOOKS

YEAR: 1977

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	2	33.33	1
Computer Science			
Knowledge			
Library Science	1	16.67	3
General			
Journalism & Publishing			
Philosophy			
Psychology			
Social Science			
Sociology			
Political Science	1	16.67	3
Economics			
Law			
Education			
Commerce			
Language (General)			
Linguistics			
Science (General)			
Mathematics and Statistics	2	33.33	1
Physics			
Chemistry			
Geology			
Biology			
Botany			
Medical Sciences			
Engineering (except Chemical Eng.)			
Agriculture			
Management			
Chemical Engineering			
Literature			
Communication			
Photography			

BOOKS

YEAR: 1978

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	3	33.33	1
Computer Science			
Knowledge			
Library Science	1	11.11	4
General			
Journalism & Publishing			
Philosophy			
Psychology			
Social Science			
Sociology			
Political Science			
Economics			
Law			
Education			
Commerce			
Language (General)			
Linguistics			
Science (General)	2	22.23	3
Mathematics and Statistics			
Physics			
Chemistry			
Geology			
Biology			
Botany			
Medical Sciences			
Engineering (except Chemical Eng.)			
Agriculture			
Management	3	33.33	1
Chemical Engineering			
Literature			
Communication			
Photography			

BOOKS

YEAR: 1979

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	8	57.12	1
Computer Science	2	14.28	2
Knowledge			
Library Science	1	7.14	3
General			
Journalism & Publishing			
Philosophy			
Psychology			
Social Science			
Sociology			
Political Science			
Economics			
Law			
Education			
Commerce			
Language (General)			
Linguistics			
Science (General)	1	7.14	3
Mathematics and Statistics			
Physics			
Chemistry			
Geology			
Biology			
Botany			
Medical Sciences			
Engineering (except Chemical Eng.)			
Agriculture			
Management	1	7.14	3
Chemical Engineering			
Literature			
Communication	1	7.14	3
Photography			

BOOKS

YEAR: Period II, 1975-1979

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	16	34.75	1
Computer Science	2	4.35	5
Knowledge			
Library Science	3	6.50	4
General			
Journalism & Publishing			
Philosophy			
Psychology	1	2.18	8
Social Science	1	2.18	8
Sociology	1	2.18	8
Political Science	1	2.18	8
Economics			
Law	1	2.18	8
Education			
Commerce			
Language (General)	1	2.18	8
Linguistics			
Science (General)	8	17.40	2
Mathematics and Statistics	2	4.35	5
Physics			
Chemistry			
Geology			
Biology			
Botany			
Medical Sciences	1	2.18	8
Engineering (except Chemical Eng.)			
Agriculture			
Management	6	13.04	3
Chemical Engineering			
Literature			
Communication	2	4.35	5
Photography			

BOOKS

YEAR: 1980

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	5	25.00	1
Computer Science	4	20.00	2
Knowledge	2	10.00	4
Library Science	4	20.00	2
General			
Journalism & Publishing			
Philosophy			
Psychology	1	5.00	5
Social Science			
Sociology			
Political Science			
Economics	1	5.00	5
Law			
Education			
Commerce			
Language (General)	1	5.00	5
Linguistics			
Science (General)			
Mathematics and Statistics	1	5.00	5
Physics			
Chemistry			
Geology			
Biology			
Botany			
Medical Sciences			
Engineering (except Chemical Eng.)			
Agriculture			
Management			
Chemical Engineering			
Literature			
Communication			
Photography	1	5.00	5

BOOKS

YEAR: 1981

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	5	20.83	1
Computer Science	5	20.83	1
Knowledge	1	4.17	6
Library Science	1	4.17	6
General			
Journalism & Publishing			
Philosophy			
Psychology	1	4.17	6
Social Science			
Sociology			
Political Science			
Economics			
Law			
Education	1	4.17	6
Commerce			
Language (General)			
Linguistics			
Science (General)	3	12.50	4
Mathematics and Statistics	5	20.83	1
Physics			
Chemistry			
Geology			
Biology			
Botany			
Medical Sciences			
Engineering (except Chemical Eng.)			
Agriculture			
Management			
Chemical Engineering			
Literature			
Communication	2	8.33	5
Photography			

BOOKS

YEAR: 1982

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	11	50.00	1
Computer Science	1	4.54	4
Knowledge	2	9.10	3
Library Science	4	18.20	2
General			
Journalism & Publishing			
Philosophy			
Psychology			
Social Science			
Sociology			
Political Science			
Economics			
Law			
Education			
Commerce			
Language (General)			
Linguistics			
Science (General)	1	4.54	4
Mathematics and Statistics			
Physics			
Chemistry	1	4.54	4
Geology			
Biology			
Botany			
Medical Sciences			
Engineering (except Chemical Eng.)	1	4.54	4
Agriculture			
Management			
Chemical Engineering			
Literature			
Communication	1	4.54	4
Photography			

BOOKS

YEAR: 1983

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	5	41.67	1
Computer Science	2	16.67	2
Knowledge			
Library Science			
General			
Journalism & Publishing			
Philosophy			
Psychology			
Social Science			
Sociology			
Political Science			
Economics	1	8.33	4
Law			
Education	1	8.33	4
Commerce			
Language (General)			
Linguistics	1	8.33	4
Science (General)			
Mathematics and Statistics			
Physics			
Chemistry			
Geology			
Biology			
Botany			
Medical Sciences			
Engineering (except Chemical Eng.)			
Agriculture			
Management	2	16.67	2
Chemical Engineering			
Literature			
Communication			
Photography			

BOOKS

YEAR: 1984

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	1	7.60	4
Computer Science			
Knowledge			
Library Science	1	7.60	4
General			
Journalism & Publishing			
Philosophy			
Psychology	1	7.60	4
Social Science			
Sociology	2	15.39	2
Political Science			
Economics	1	7.60	4
Law			
Education			
Commerce			
Language (General)			
Linguistics			
Science (General)	2	15.39	2
Mathematics and Statistics	4	30.77	1
Physics			
Chemistry			
Geology			
Biology			
Botany			
Medical Sciences			
Engineering (except Chemical Eng.)			
Agriculture			
Management	1	7.60	4
Chemical Engineering			
Literature			
Communication			
Photography			

BOOKS

YEAR: 1985

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	6	37.50	1
Computer Science	4	25.00	2
Knowledge			
Library Science	2	12.50	3
General			
Journalism & Publishing			
Philosophy			
Psychology			
Social Science			
Sociology	2	12.50	3
Political Science			
Economics			
Law			
Education			
Commerce			
Language (General)			
Linguistics			
Science (General)	1	6.25	5
Mathematics and Statistics	1	6.25	5
Physics			
Chemistry			
Geology			
Biology			
Botany			
Medical Sciences			
Engineering (except Chemical Eng.)			
Agriculture			
Management			
Chemical Engineering			
Literature			
Communication			
Photography			

BOOKS

YEAR: Period III, 1980-1985

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	33	30.84	1
Computer Science	16	14.95	2
Knowledge	5	4.67	6
Library Science	12	11.22	3
General			
Journalism & Publishing			
Philosophy			
Psychology	3	2.80	8
Social Science			
Sociology	4	3.73	7
Political Science			
Economics	3	2.80	8
Law			
Education	2	1.87	12
Commerce			
Language (General)	1	.94	13
Linguistics	1	.94	13
Science (General)	7	6.53	5
Mathematics and Statistics	11	10.25	4
Physics			
Chemistry	1	.94	13
Geology			
Biology			
Botany			
Medical Sciences			
Engineering (except Chemical Eng.)	1	.94	13
Agriculture			
Management	3	2.80	8
Chemical Engineering			
Literature			
Communication	3	2.80	8
Photography	1	.94	13

APPENDIX D

JOURNAL CITATIONS PUBLISHED IN JASIS FROM 1970 THROUGH 1985

JOURNALS

YEAR: 1970

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	11	44.00	1
Computer Science	1	4.00	3
Knowledge			
Library Science	1	4.00	3
General			
Journalism & Publishing	1	4.00	3
Philosophy			
Psychology	1	4.00	3
Social Science			
Sociology			
Political Science			
Economics			
Law			
Education			
Commerce			
Language (General)			
Linguistics			
Science (General)	1	4.00	3
Mathematics and Statistics			
Physics			
Chemistry	4	16.00	2
Geology			
Biology			
Botany			
Medical Sciences	1	4.00	3
Engineering (except Chemical Eng.)			
Agriculture			
Management	1	4.00	3
Chemical Engineering	1	4.00	3
Literature			
Communication			
Photography			

JOURNALS

YEAR: 1971

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	14	35.90	1
Computer Science	2	5.10	3
Knowledge	2	5.10	3
Library Science	9	23.10	2
General	1	2.60	9
Journalism & Publishing	1	2.60	9
Philosophy			
Psychology	2	5.10	3
Social Science			
Sociology			
Political Science	2	5.10	3
Economics			
Law			
Education	1	2.60	9
Commerce			
Language (General)			
Linguistics			
Science (General)	2	5.60	3
Mathematics and Statistics	2	5.60	3
Physics			
Chemistry	1	2.60	
Geology			
Biology			
Botany			
Medical Sciences			
Engineering (except Chemical Eng.)			
Agriculture			
Management			
Chemical Engineering			
Literature			
Communication			
Photography			

JOURNALS

YEAR: 1972

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	30	48.50	1
Computer Science	4	6.50	3
Knowledge			
Library Science	12	19.40	2
General	1	1.60	8
Journalism & Publishing			
Philosophy	1	1.60	8
Psychology			
Social Science			
Sociology			
Political Science	1	1.60	8
Economics	2	3.20	4
Law			
Education			
Commerce			
Language (General)			
Linguistics			
Science (General)	2	3.20	4
Mathematics and Statistics			
Physics			
Chemistry	1	1.60	8
Geology	1	1.60	8
Biology			
Botany			
Medical Sciences	1	1.60	8
Engineering (except Chemical Eng.)	1	1.60	8
Agriculture	1	1.60	8
Management	2	3.30	4
Chemical Engineering	2	3.20	4
Literature			
Communication			
Photography			

JOURNALS

YEAR: 1973

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	17	41.40	1
Computer Science	3	7.50	4
Knowledge			
Library Science	5	12.20	3
General			
Journalism & Publishing			
Philosophy			
Psychology	6	14.60	2
Social Science			
Sociology	2	4.86	5
Political Science			
Economics	1	2.43	8
Law			
Education	2	4.86	5
Commerce			
Language (General)			
Linguistics			
Science (General)	1	2.43	8
Mathematics and Statistics			
Physics			
Chemistry	1	2.43	8
Geology			
Biology			
Botany			
Medical Sciences	1	2.43	8
Engineering (except Chemical Eng.)			
Agriculture			
Management	2	4.86	5
Chemical Engineering			
Literature			
Communication			
Photography			

JOURNALS

YEAR: 1974

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	32	51.70	1
Computer Science	5	8.11	2
Knowledge			
Library Science	5	8.11	2
General	1	1.60	9
Journalism & Publishing	1	1.60	9
Philosophy			
Psychology	1	1.60	9
Social Science			
Sociology			
Political Science	2	3.20	6
Economics			
Law	1	1.60	9
Education			
Commerce			
Language (General)	2	3.20	6
Linguistics	2	3.20	6
Science (General)	3	4.80	4
Mathematics and Statistics			
Physics	1	1.60	9
Chemistry	3	4.80	4
Geology			
Biology			
Botany			
Medical Sciences			
Engineering (except Chemical Eng.)	1	1.60	9
Agriculture			
Management			
Chemical Engineering	1	1.60	9
Literature	1	1.60	9
Communication			
Photography			

JOURNALS

YEAR: Period I, 1970-1974

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	104	45.30	1
Computer Science	15	6.55	3
Knowledge	2	.88	15
Library Science	32	14.00	2
General	3	1.30	10
Journalism & Publishing	3	1.30	10
Philosophy			
Psychology	11	4.80	4
Social Science			
Sociology	2	.88	15
Political Science	5	2.20	7
Economics	3	1.30	10
Law	1	.44	21
Education	3	1.30	10
Commerce			
Language (General)	2	.88	15
Linguistics	2	.88	15
Science (General)	9	3.95	6
Mathematics and Statistics	2	.88	15
Physics	1	.44	21
Chemistry	10	4.39	5
Geology	1	.44	21
Biology	1	.44	21
Botany	1	.44	21
Medical Sciences	3	1.30	10
Engineering (except Chemical Eng.)	2	.88	15
Agriculture	1	.44	21
Management	5	2.20	7
Chemical Engineering	4	1.75	9
Literature	1	.44	21
Communication			
Photography			

JOURNALS

YEAR: 1975

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	22	46.80	1
Computer Science	2	4.26	4
Knowledge			
Library Science	8	17.00	2
General			
Journalism & Publishing	1	2.13	8
Philosophy			
Psychology	2	4.26	4
Social Science			
Sociology			
Political Science			
Economics			
Law			
Education	2	4.26	4
Commerce			
Language (General)			
Linguistics			
Science (General)	5	10.64	3
Mathematics and Statistics			
Physics			
Chemistry	1	2.13	8
Geology			
Biology	1	2.13	8
Botany			
Medical Sciences	2	4.26	4
Engineering (except Chemical Eng.)			
Agriculture			
Management	1	2.13	8
Chemical Engineering			
Literature			
Communication			
Photography			

JOURNALS

YEAR: 1976

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	31	44.29	1
Computer Science	13	18.59	2
Knowledge	2	2.86	6
Library Science	6	8.58	4
General			
Journalism & Publishing			
Philosophy	1	1.42	7
Psychology			
Social Science			
Sociology			
Political Science			
Economics			
Law			
Education	1	1.42	7
Commerce			
Language (General)	1	1.42	7
Linguistics	1	1.42	7
Science (General)	5	7.15	5
Mathematics and Statistics	1	1.42	7
Physics			
Chemistry	7	10.01	3
Geology			
Biology			
Botany			
Medical Sciences			
Engineering (except Chemical Eng.)	1	1.42	7
Agriculture			
Management			
Chemical Engineering			
Literature			
Communication			
Photography			

JOURNALS

YEAR: 1977

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	15	27.30	1
Computer Science	7	12.70	3
Knowledge			
Library Science	15	27.30	1
General			
Journalism & Publishing			
Philosophy			
Psychology	1	1.82	9
Social Science			
Sociology	2	3.64	7
Political Science			
Economics	2	3.64	7
Law			
Education			
Commerce	1	1.82	9
Language (General)			
Linguistics	1	1.82	9
Science (General)	5	9.09	4
Mathematics and Statistics			
Physics			
Chemistry	3	5.45	5
Geology			
Biology			
Botany			
Medical Sciences			
Engineering (except Chemical Eng.)			
Agriculture			
Management	3	5.45	5
Chemical Engineering			
Literature			
Communication			
Photography			

JOURNALS

YEAR: 1978

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	22	44.00	1
Computer Science	5	10.00	4
Knowledge			
Library Science	9	18.00	2
General			
Journalism & Publishing			
Philosophy			
Psychology	1	2.00	6
Social Science			
Sociology			
Political Science			
Economics			
Law			
Education			
Commerce			
Language (General)			
Linguistics	2	4.00	5
Science (General)	6	12.00	3
Mathematics and Statistics			
Physics	1	2.00	6
Chemistry	1	2.00	6
Geology			
Biology			
Botany			
Medical Sciences			
Engineering (except Chemical Eng.)	1	2.00	6
Agriculture			
Management	1	2.00	6
Chemical Engineering	1	2.00	6
Literature			
Communication			
Photography			

JOURNALS

YEAR: 1979

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	26	53.06	1
Computer Science	7	14.29	2
Knowledge			
Library Science	7	14.29	2
General			
Journalism & Publishing			
Philosophy			
Psychology			
Social Science			
Sociology			
Political Science			
Economics	1	2.04	6
Law			
Education	1	2.04	6
Commerce			
Language (General)			
Linguistics			
Science (General)	5	10.20	4
Mathematics and Statistics			
Physics			
Chemistry			
Geology			
Biology			
Botany			
Medical Sciences			
Engineering (except Chemical Eng.)			
Agriculture			
Management	2	4.08	5
Chemical Engineering			
Literature			
Communication			
Photography			

JOURNALS

YEAR: Period II, 1975-1979

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	116	42.80	1
Computer Science	34	12.53	3
Knowledge	2	.74	11
Library Science	45	16.60	2
General			
Journalism & Publishing	1	.37	15
Philosophy	1	.37	15
Psychology	4	1.48	7
Social Science			
Sociology	2	.74	11
Political Science			
Economics	3	1.10	10
Law			
Education	4	1.48	7
Commerce	1	.37	15
Language (General)	1	.37	15
Linguistics	4	1.48	7
Science (General)	26	9.60	4
Mathematics and Statistics	1	.37	15
Physics	1	.37	15
Chemistry	12	4.43	5
Geology			
Biology	1	.37	15
Botany			
Medical Sciences	2	.74	11
Engineering (except Chemical Eng.)	2	.74	11
Agriculture			
Management	7	2.58	6
Chemical Engineering	1	.37	15
Literature			
Communication			
Photography			

JOURNALS

YEAR: 1980

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	27	45.32	1
Computer Science	6	10.70	3
Knowledge			
Library Science	13	22.00	2
General			
Journalism & Publishing			
Philosophy			
Psychology	1	1.70	6
Social Science			
Sociology	1	1.70	6
Political Science			
Economics			
Law			
Education			
Commerce			
Language (General)			
Linguistics			
Science (General)	5	8.48	4
Mathematics and Statistics			
Physics	1	1.70	6
Chemistry	3	5.00	5
Geology			
Biology	1	1.70	6
Botany			
Medical Sciences			
Engineering (except Chemical Eng.)			
Agriculture			
Management			
Chemical Engineering	1	1.70	6
Literature			
Communication			
Photography			

JOURNALS

YEAR: 1981

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	38	38.78	1
Computer Science	19	19.39	2
Knowledge			
Library Science	8	8.16	4
General	1	1.02	10
Journalism & Publishing			
Philosophy			
Psychology	7	7.14	5
Social Science	1	1.02	10
Sociology	1	1.02	10
Political Science			
Economics	2	2.04	6
Law			
Education			
Commerce			
Language (General)			
Linguistics			
Science (General)	11	11.23	3
Mathematics and Statistics	1	1.02	10
Physics			
Chemistry	1	1.02	10
Geology			
Biology			
Botany			
Medical Sciences	1	1.02	10
Engineering (except Chemical Eng.)	2	2.04	6
Agriculture			
Management	2	2.04	6
Chemical Engineering	1	1.02	10
Literature			
Communication	2	2.04	6
Photography			

JOURNALS

YEAR: 1982

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	29	46.03	1
Computer Science	8	12.70	2
Knowledge	1	1.59	7
Library Science	8	12.70	2
General			
Journalism & Publishing			
Philosophy			
Psychology	2	3.18	6
Social Science			
Sociology	1	1.59	7
Political Science			
Economics	3	4.74	5
Law			
Education			
Commerce			
Language (General)			
Linguistics			
Science (General)	8	12.70	2
Mathematics and Statistics	1	1.59	7
Physics			
Chemistry			
Geology			
Biology			
Botany			
Medical Sciences			
Engineering (except Chemical Eng.)	1	1.59	7
Agriculture			
Management	1	1.59	7
Chemical Engineering			
Literature			
Communication			
Photography			

JOURNALS

YEAR: 1983

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	39	42.86	1
Computer Science	18	19.74	2
Knowledge	1	1.10	9
Library Science	6	6.60	4
General			
Journalism & Publishing			
Philosophy			
Psychology	3	3.30	6
Social Science	2	2.20	8
Sociology			
Political Science			
Economics			
Law			
Education	1	1.10	9
Commerce			
Language (General)			
Linguistics			
Science (General)	9	9.90	3
Mathematics and Statistics	1	1.10	9
Physics	1	1.10	9
Chemistry	1	1.10	9
Geology			
Biology	1	1.10	9
Botany			
Medical Sciences	1	1.10	9
Engineering (except Chemical Eng.)	3	3.30	6
Agriculture			
Management	4	4.40	5
Chemical Engineering			
Literature			
Communication			
Photography			

JOURNALS

YEAR: 1984

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	24	35.70	1
Computer Science	15	23.44	2
Knowledge			
Library Science	5	7.81	4
General			
Journalism & Publishing			
Philosophy			
Psychology	3	4.69	5
Social Science	1	1.56	7
Sociology	2	3.13	6
Political Science			
Economics			
Law			
Education			
Commerce			
Language (General)			
Linguistics	1	1.56	7
Science (General)	11	17.19	3
Mathematics and Statistics			
Physics			
Chemistry			
Geology			
Biology			
Botany			
Medical Sciences	1	1.56	7
Engineering (except Chemical Eng.)	1	1.56	7
Agriculture			
Management			
Chemical Engineering			
Literature			
Communication			
Photography			

JOURNALS

YEAR: 1985

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	41	47.00	1
Computer Science	17	19.50	2
Knowledge			
Library Science	2	2.30	7
General			
Journalism & Publishing	1	1.14	9
Philosophy			
Psychology	6	6.90	3
Social Science			
Sociology	1	1.14	9
Political Science			
Economics			
Law	1	1.14	9
Education	3	3.40	6
Commerce			
Language (General)			
Linguistics			
Science (General)	5	5.70	4
Mathematics and Statistics	1	1.14	9
Physics			
Chemistry	2	2.30	7
Geology			
Biology			
Botany			
Medical Sciences	1	1.14	9
Engineering (except Chemical Eng.)			
Agriculture			
Management	5	5.70	4
Chemical Engineering	1	1.14	9
Literature			
Communication			
Photography			

JOURNALS

YEAR: Period III, 1980-1985

DISCIPLINE	NUMBER	PERCENTAGE	RANK
Information Science	198	42.86	1
Computer Science	83	17.97	2
Knowledge	2	.43	15
Library Science	42	9.08	4
General	1	.22	20
Journalism & Publishing	1	.22	20
Philosophy			
Psychology	22	4.76	5
Social Science	4	.87	11
Sociology	6	1.29	9
Political Science			
Economics	5	1.09	10
Law	1	.22	20
Education	4	.87	6
Commerce			
Language (General)			
Linguistics	1	.22	20
Science (General)	49	10.61	3
Mathematics and Statistics	3	.65	14
Physics	2	.43	15
Chemistry	8	1.73	7
Geology			
Biology	2	.43	15
Botany			
Medical Sciences	4	.87	11
Engineering (except Chemical Eng.)	7	1.58	8
Agriculture			
Management	13	2.81	6
Chemical Engineering	2	.43	15
Literature			
Communication	2	.43	15
Photography			

APPENDIX E

The Evolution of the Contributions of Some Disciplines to Information Science From 1970 through 1985

DISCIPLINE: Information Science

YEAR	BOOKS		JOURNALS		TOTAL	
	NO.	PERCENT	NO.	PERCENT	NO.	PERCENT
1970	3	23.00	11	44.00	14	36.90
1971	10	43.50	14	35.90	24	39.00
1972	5	33.40	30	48.50	35	45.50
1973	10	41.70	17	41.40	27	41.50
1974	7	58.30	32	51.70	39	52.70
TOTAL PER. 1	35	40.25	104.	45.30	139	43.80
1975	1	11.11	22	46.80	23	41.10
1976	2	25.00	31	44.29	33	42.30
1977	2	33.33	15	27.30	17	27.87
1978	3	33.33	22	44.00	25	42.36
1979	8	57.12	26	53.06	34	53.97
TOTAL PER. 2	16	34.7[illegible]	116	42.80	132	41.63
1980	5	25.00	27	45.32	32	40.50
1981	5	20.83	38	38.87	43	35.25
1982	11	50.00	29	46.03	40	47.06
1983	5	41.67	39	42.86	44	42.72
1984	1	7.60	24	37.50	25	32.47
1985	6	37.50	41	47.00	47	45.70
TOTAL PER. 3	33	30.84	198	42.86	231	40.60
TOTAL	84	34.71	418	43.54	502	41.76

DISCIPLINE: Computer Science

YEAR	BOOKS		JOURNALS		TOTAL	
	NO.	PERCENT	NO.	PERCENT	NO.	PERCENT
1970	1	7.70	1	4.00	2	5.20
1971			2	5.10	2	3.20
1972	1	6.70	4	6.50	5	6.50
1973	1	4.16	3	7.50	4	6.13
1974	1	8.40	5	8.11	6	8.12
TOTAL PER. 1	4	4.60	15	6.55	19	6.02
1975			2	4.26	2	3.58
1976			13	18.59	13	16.67
1977			7	12.70	7	11.48
1978			5	10.00	5	8.47
1979	2	14.28	7	14.29	9	14.29
TOTAL PER. 2	2	4.35	34	12.53	36	11.35
1980	4	20.00	6	10.70	10	12.65
1981	5	20.83	19	19.39	24	19.76
1982	1	4.54	8	12.70	9	10.59
1983	2	16.67	18	19.74	20	19.42
1984	1	7.60	24	23.44	25	19.50
1985	6	37.50	41	19.50	47	20.40
TOTAL PER. 3	16	14.95	83	17.97	99	17.43
TOTAL	22	9.10	132	13.74	154	12.81

DISCIPLINE: Library Science

YEAR	BOOKS		JOURNALS		TOTAL	
	NO.	PERCENT	NO.	PERCENT	NO.	PERCENT
1970	1	7.70	1	4.00	2	5.20
1971	4	17.40	9	23.10	13	21.00
1972	4	26.60	12	19.40	16	20.80
1973	4	16.70	5	12.20	9	13.83
1974			5	8.10	5	6.80
TOTAL PER. 1	13	14.90	32	14.00	45	14.28
1975			8	17.00	8	14.30
1976			6	8.58	6	7.70
1977	1	16.67	15	27.00	16	26.23
1978	1	11.11	9	18.00	10	16.95
1979	1	7.15	7	14.29	8	12.70
TOTAL PER. 2	3	6.50	45	16.60	48	15.13
1980	4	20.00	13	22.00	17	21.50
1981	1	4.17	8	8.16	9	7.35
1982	4	18.20	8	12.70	12	14.11
1983			6	6.60	6	5.83
1984	1	7.60	5	7.81	6	7.80
1985	2	12.50	2	2.30	4	3.90
TOTAL PER. 3	12	11.22	42	9.10	54	9.40
TOTAL	28	11.76	119	12.40	147	12.20

DISCIPLINE: Science (General; DDC 500)

YEAR	BOOKS		JOURNALS		TOTAL	
	NO.	PERCENT	NO.	PERCENT	NO.	PERCENT
1970	4	31.00	1	4.00	5	13.20
1971	1	4.30	2	5.10	3	4.80
1972	1	6.70	2	3.20	3	3.96
1973	2	8.30	1	2.43	3	4.62
1974	1	8.30	3	4.80	4	5.40
TOTAL PER. 1	9	10.35	9	3.95	18	5.71
1975	1	11.11	5	10.64	6	10.70
1976	4	50.00	5	7.15	9	11.54
1977			5	9.09	5	8.20
1978	2	22.23	6	12.00	8	13.56
1979	1	7.15	5	10.20	6	9.52
TOTAL PER. 2	8	17.40	26	9.60	34	10.72
1980			5	8.48	5	6.33
1981	3	12.50	11	11.23	14	11.48
1982	1	4.54	8	12.70	9	10.59
1983			9	9.90	9	8.74
1984	2	15.39	11	17.19	13	16.83
1985	1	6.25	5	5.70	6	5.83
TOTAL PER. 3	7	6.54	49	10.61	56	9.84
TOTAL	24	9.92	84	8.75	108	9.00

DISCIPLINE: Psychology

YEAR	BOOKS		JOURNALS		TOTAL	
	NO.	PERCENT	NO.	PERCENT	NO.	PERCENT
1970			1	4.00	1	2.60
1971	1	4.34	2	5.10	3	4.80
1972			1	1.60	1	1.30
1973	1	4.16	6	14.60	7	10.70
1974	2	16.70	1	1.60	3	4.10
TOTAL PER. 1	4	4.60	11	4.80	15	4.76
1975	1	11.11	2	4.26	3	5.36
1976						
1977			1	1.82	1	1.64
1978			1	2.00	1	1.70
1979						
TOTAL PER. 2	1	2.18	4	1.48	5	1.57
1980	1	5.00	1	1.70	2	2.53
1981	1	4.17	7	7.14	8	6.56
1982			2	3.18	2	2.35
1983			3	3.30	3	2.91
1984	1	7.60	3	4.69	4	5.20
1985			6	6.90	6	5.83
TOTAL PER. 3	3	2.80	22	4.76	25	4.40
TOTAL	8	3.31	37	3.85	45	3.74

DISCIPLINE: Management

YEAR	BOOKS		JOURNALS		TOTAL	
	NO.	PERCENT	NO.	PERCENT	NO.	PERCENT
1970			1	4.00	1	2.60
1971	1	4.30			1	1.60
1972	2	13.30	2	3.20	4	3.96
1973			2	4.88	2	3.10
1974						
TOTAL PER. 1	3	3.45	5	2.20	8	2.54
1975	2	22.22	1	2.13	3	5.34
1976						
1977			3	5.45	3	4.91
1978	3	33.33	1	2.00	4	6.70
1979	1	7.15	2	4.08	3	4.75
TOTAL PER. 2	6	13.04	7	2.58	13	4.10
1980			1	1.70	1	1.27
1981			2	2.04	2	1.64
1982			1	1.59	1	1.18
1983	2	16.67	4	4.40	6	5.83
1984	1	7.60			1	1.30
1985			5	5.70	5	5.00
TOTAL PER. 3	3	2.80	13	2.81	16	2.81
TOTAL	12	4.96	25	2.60	37	3.08

DISCIPLINE: Chemistry*

YEAR	BOOKS		JOURNALS		TOTAL	
	NO.	PERCENT	NO.	PERCENT	NO.	PERCENT
1970	1	7.70	4	16.00	5	13.30
1971			1	2.60	1	1.60
1972			1	1.60	1	1.30
1973			1	2.43	1	1.55
1974	1	8.30	3	4.80	4	5.40
TOTAL PER. 1	2	2.30	10	4.39	12	3.81
1975			1	2.13	1	1.78
1976			7	10.01	7	9.00
1977			3	5.45	3	4.91
1978			1	2.00	1	1.70
1979						
TOTAL PER. 2			12	4.43	12	3.79
1980			3	5.00	3	3.80
1981			1	1.02	1	.82
1982	1	4.54	1	1.59	2	2.35
1983			1	1.10	1	.97
1984						
1985			2	2.30	2	1.94
TOTAL PER. 3	1	.94	8	1.73	9	1.58
TOTAL	3	1.24	30	3.13	33	2.75

* The Journal of Chemical Documentation, which later became the Journal of Chemical Information and Computer Science, was classified as a chemistry journal.

DISCIPLINE: Mathematics & Statistics
(DDC 510-519.99)

YEAR	BOOKS		JOURNALS		TOTAL	
	NO.	PERCENT	NO.	PERCENT	NO.	PERCENT
1970	3	23.00			3	8.00
1971			2	5.10	2	3.20
1972						
1973	3	12.50			3	4.62
1974						
TOTAL PER. 1	6	6.90	2	.88	8	2.54
1975						
1976			1	1.42	1	1.28
1977	2	33.33			2	3.28
1978						
1979						
TOTAL PER. 2	2	4.35	1	.37	3	.95
1980	1	5.00			1	1.27
1981	5	20.83	1	1.02	6	4.92
1982						
1983			1	1.10	1	.97
1984	4	30.77			4	5.20
1985	1	6.25	1	1.14	2	1.94
TOTAL PER. 3	11	10.28	3	.65	14	2.46
TOTAL	19	7.85	6	.63	25	2.08

DISCIPLINE: All Other Disciplines

YEAR	BOOKS		JOURNALS		TOTAL	
	NO.	PERCENT	NO.	PERCENT	NO.	PERCENT
1970			5	20.00	5	20.00
1971	6	26.60	7	18.00	13	19.40
1972	2	13.30	10	16.20	12	10.40
1973	3	12.50	6	14.60	9	13.83
1974			13	21.02	13	17.52
TOTAL PER. 1	11	13.35	41	17.92	52	16.50
1975	4	44.44	6	12.77	10	17.88
1976	2	25.00	5	7.15	7	9.00
1977	1	16.67	6	10.90	7	11.48
1978			5	10.00	5	8.47
1979	1	7.15	2	4.08	3	4.75
TOTAL PER. 2	8	17.40	26	9.60	34	10.72
1980	5	25.00	2	3.40	7	8.87
1981	4	16.67	11	11.23	15	12.30
1982	4	18.20	6	9.51	10	11.77
1983	3	24.99	10	11.00	13	12.63
1984	3	22.99	6	9.37	9	11.70
1985	2	17.5	8	9.18	10	9.71
TOTAL PER. 3	21	19.62	43	9.32	64	11.24
TOTAL	40	16.53	110	11.46	150	12.48

APPENDIX F

The Journals That Were Cited by the Authors of JASIS Articles From January, 1970 Through December, 1985

Year	Journal
1970	American Documentation
	American Psychological Review
	Annual Review of Information Science and Technology
	ASM Information Searching
	Biblio. Society of America Papers
	Bulletin of the Medical Library Ass.
	Chemistry and Industry
	Datamation
	Information Scientist
	Institute of Biology Journal
	IRE Transactions on Engineering Management
	Journal of Chemical Documentation
	Journal of Documentation
	Journal of Experimental Medicine
	Science
	Texon
1971	American Behavioral Scientist
	American Documentation
	American Psychologist
	American Scholars
	Annual Review of Information Science and Technology
	ASLIB Proceedings
	Atlantic Monthly
	Behavioral Science
	College and Research Libraries
	IEEE Transactions on Systems, Man and Cybernetics
	Information Storage and Retrieval
	JASIS
	Journal of Chemical Documentation
	Journal of Education For Librarianship
	Journal of Library Automation
	Journal of the ACM
	Journal of the American Statistical Ass.
	Journal of the Royal Statistical Society
	Library Journal
	Libri
	Nature

Pub. Weekly
Science
Special Libraries
Wilson Library Bulletin

1972 Agriculture Science Review
American Documentation
American Economics Review
Annual Review of Information Science and Technology
ASLIB Proceedings
Atlantic Monthly
Chemical Engineering News
Chemistry and Industry
College and Research Libraries
Communications of the ACM
Geological Survey Bulletin
Information Scientist
Information Storage and Retrieval
Institute of Personnel Management and the Industrial Society
JASIS
Journal of Chemical Documentation
Journal of Documentation
Journal of Library Automation
Journal of the ACM
Library Journal
Library Quarterly
Management Today
Methods of Information in Medicine
Nature
Psychological Bulletin
Science
Simulation
Technology Review

1973 Administrative Science Quarterly
Advances in Librarianship
American Documentation
American Economics Review
American Psychologist
American Sociological Review
American Sociologist

Annual Review of Information Science and Technology
Archives of Psychology
ASLIB Proceedings
Drug Information Bulletin
Educational Technology
IEEE Transactions on Bio-Madical Engineering
Information Storage and Retrieval
JASIS
Journal of Abnormal and Social Psychology
Journal of Library Automation
Journal of Research and Development
Journal of the ACM
Library Journal
Management Science
Psychological Monographs
Science
Special Libraries

1974

ALA Bulletin
American Behavioral Scientist
American Documentation
American Patent Law Ass. Bulletin
Annual Review of Information Science and Technology
ASLIB Proceedings
ATA Chronicle
Atlantic Monthly
Babel
Chemical Engineering News
Cognitive Psychology
Communications of the ACM
Computer Journal
Daedalus
Datamation
IEEE Transactions on Engineering Writing and Speech
Information Storage and Retrieval
JASIS
Journal of Chemical Documentation Journal of Documentation
Journal of the ACM
Library Journal

Meta
Nachrichten fur Dokumentation
Newsweek
Oak Ridge National Laboratory Review
Saturday Review
Scholarly Publishing
Science

1975 American Documentation
Annals of Eugenics
ASLIB Proceedings
College and Research Libraries
Information Storage and Retrieval
International Library Review
JASIS
Journal of Applied Psychology
Journal of Chemical Documentation
Journal of Documentation
Journal of Education for Librarianship
Journal of Educational Research
Journal of Experimental Education
Journal of Nursing Research
Journal of the ACM
Journalism Quarterly
Library Ass. Records
Library Journal
Library Quarterly
Library Trends
Management Science
Nature
Nursing Research
Operational Research Quarterly
Science

1976 American Documentation
Annual Review of Information Science and Technology
BASIS
College and Research Libraries
Computer Journal
Computing Review
Cybernetica
Elementary English

Information and Control
Information Scientist
Information Storage and Retrieval
JASIS
Journal of Chemical Documentation
Journal of Chemical Information and Computer Science
Journal of Documentation
Journal of Educational Psychology
Journal of Library Automation
Journal of the ACM
Kolloidnyi Zhurnal
Library Journal
Library Resources and Technical Services
Materials Research and Standards
Nature
Operational Research Quarterly
Operations Research
Philosophical Transactions of the Royal Society
Progress in Cybernetics
Psycholinguistics
Science
SIAM Journal on Computing
Societe Chimique de France
Special Libraries

1977

Advances in Librarianship
American Documentation
American Economics Review
American Sociologist
Annual Review of Information Science and Technology
Bell Systems Technical Journal Canadian Library Journal
College and Research Libraries
Commerce Today
Computer Journal
Current Trends in Linguistics
Drexel Library Quarterly
Harvard Business Review
IEEE Transactions on Software Engineering
Information Storage and Retrieval

JASIS
Journal of Academic Librarianship
Journal of Chemical Documentation
Journal of Chemical Information and Computer Science
Journal of Documentation
Journal of Economic Literature
Journal of Experimental Psychology
Journal of Library Automation
Journal of the ACM
Library Journal
Library Resources and Technical Services
Management Science
OCLC Newsletter
Research Management
Science
Scientific America
SIGSOC Bulletin
Sociological Quarterly
Special Libraries
U.S. Library of Congress Information Bulletin
Wilson Library Bulletin

1978 American Documentation
American Journal of Computational Linguistics
American Libraries
Annual Review of Information Science and Technology
Applied Optics
ARL Management Supplement
Chemical Engineering News
College and Research Libraries
Communications of the ACM
Computer
Drexel Library Quarterly
IEEE Transactions on Professional Communication
Information Processing and Management
Information Storage and Retrieval
International Library Review
JASIS
Journal of Academic Librarianship Journal of Chemical Documentation

Journal of Documentation
Journal of the ACM
Library Quarterly
Library Trends
Linguistics
Management Science
Online Review
Psychological Reports
Science News
Social Studies of Science
Special Libraries

1979 American Documentation
Annual Review of Information Science and Technology
BASIS
Bulletin of the Medical Library Ass.
College and Research Libraries
Communications of the ACM
Computer Journal
Director
Information Processing and Management
Information Storage and Retrieval
International Library Review
JASIS
Journal of Documentation
Journal of Library Automation
Journal of the ACM
Management Science
Minerva
Online
Public Finance Quarterly
Science
Transactions of the New York Academy of Science
Utah Libraries

1980 AIBS Bulletin
American Documentation
American Psychologist
American Scientist
American Sociological Review
Annual Review of Information Science and Technology

Applied Optics
BASIS
Bibliography, Documentation, Terminology
British Journal of the Philosophy of Science
College and Research Libraries
Communications of the ACM
Datamation
Drexel Library Quarterly
FID News Bulletin
Harvard Business Review
IEEE Transactions on Computers
Information and Control
Information Processing and Management
JASIS
Journal of Cataloging and Classification
Journal of Chemical Documentation
Journal of Chemical Information and Computer Science
Journal of Communication
Journal of Documentation
Journal of Education for Librarianship
Journal of Library Automation
Library Journal
Library Quarterly
Library Trends
Online
RQ
Science
Scientific America
Unesco Bulletin for Libraries

1981

ACM Transactions on Database Systems
Administrative Management
American Economics Review
American Psychologist
American Sociologist
Annals of Internal Medicine
Annual Review of Information Science and Technology
Artificial Intelligence
Atlantic Monthly
Bell System Technical Journal
Bulletin of Medical Library Ass.

Chemical Engineering News
Cognitive Psychology
Cognitive Science
Communications of the ACM
Communications Policy
Computer
Computing Surveys
Datamation
Director
Human Perception and Performance
IBM Journal of Research and Development
IBM Systems Journal
IEEE Proceedings
IEEE Transactions on Consumer Electronics
Information Processing and Management
Information Scientist
Information Storage and Retrieval
JASIS
Journal of Academic Librarianship
Journal of Chemical Information and Computer Science
Journal of Documentation
Journal of the ACM
Journal of the Royal Statistical Society
Library Journal
Library Quarterly
Nature
Online
Online Review
Psychological Review
Psychology Review of Economics and Statistics
Science Studies
Serials Librarian
Social Science Research
Wilson Library Bulletin

1982

American Documentation
American Economics Review
American Psychologist
American Psychological Review
Annual Review of Information Science and Technology
ASLIB Proceedings

Collection Management
College and Research Libraries
Communications of the ACM
IEEE Transactions on Man, System and Cybernetics
Information Processing and Management
Information Storage and Retrieval
JASIS
Journal of Applied Psychology
Journal of Chemical Documentation
Journal of Documentation
Journal of Economic Literature
Journal of Political Economy
Journal of the ACM
Library Research
Library Trends
Management Science
Online Review
Science
Science Studies
Scientometrics
Social Studies of Science
Special Libraries
Technology Review
Wilson Library Bulletin

1983 ACM SIGIR Forum
Annual Review of Information Science and Technology
Asst. Librarian
Bulletin of the Medical Library Ass.
BYTE
College and Research Libraries
Communications of the ACM
Computer
Database
Euronet DIANE News
Harvard Business Review
Human Biology
Human Factors
IEEE Transactions on Consumer Electronics
IEEE Transactions on Professional Communication

IEEE Transactions on Systems, Man and Cybernetics
Information Processing and Management
Information Scientist
Information Storage and Retrieval
Information Systems
International Journal of Man-Machine Studies
JASIS
Journal of Documentation
Journal of Industrial Engineering
Journal of Verbal Learning and Verbal Behavior
Librarian
Library Research
Management Science
MIS Quarterly
Nature
Nebraska Videodisk News
New England Journal of Medicine
Online
Online Review
Psychological Review
Psychometrics
SIGPLAN Notices
Social Science Information Studies
Sociology of Education
Trends in Biochemical Sciences
Zeitschrift fur Physik

1984

ACM SIGIR Forum
ACM Transactions on Database Systems
Al-Mijallah Al-Arabia Lil-Ulum
American Psychologist
Annals of Internal Medicine
Artificial Intelligence
Bell System Technical Journal
College and Research Libraries
Communications of the ACM
Computer Journal
IEEE Transactions on Computers
IEEE Transactions on Professional Communication
Information Processing and Management
Information Storage and Retrieval

Information Systems
Information Technology: R&D
JASIS
Journal of Computer and Information Science
Journal of Documentation
Journal of Informatics
Journal of Information Science
Journal of Library Automation
Journal of the ACM
Lecture Notes in Computer Science
Library Resources and Technical Services
Mechanical Translation
Psychnamic Monograph Supplements
Psychometrika
Science
Science Studies
Scientometrics
Social Studies of Science
Sociological Review
Sociology
Software Practice and Experience

1985 ACM SIGIR Forum
ACM SIGIR Newsletter
ACM Transactions on Database Systems
American Documentation
American Psychologist
American Psychological Review
Annual Review of Information Science and Technology
BASIS
Business Week
Canadian Journal for Information Science
Cognitive Science
Communications of the ACM
Computing Surveys
Datamation
Decision Sciences
Developmental Psychology
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Electronic Learning
IEEE Transactions on Engineering Management
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INFOR
Information Processing and Management
Information Scientist
Information Storage and Retrieval
Information Technology: R&D
InfoWorld
International Journal of Man-Machine Studies
JASIS
Journal of Applied Psychology
Journal of Chemical Information and Computer Science
Journal of Child Psychology and Allied Disciplines
Journal of Documentation
Journal of Information Science
Journal of Legal Education
Journal of Medical Education
Journal of Research Communication Studies
Journal of the ACM
Journal of the Royal Statistical Society
Library Journal
Library Trends
Management Science
Nachrichten fur Dokumentation
Nature
New Zealand Journal of Psychology
Online
PAMI
Phi Delta Kappan
Scholarly Publishing
Science
Sciences, The
Scientometrics

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Education

B.Sc., Statistics	The University of Baghdad, Iraq, 1976.
H.D.L.S.D*	The University of Baghdad, Iraq, 1977.
MLS	Indiana University, Bloomington, Indiana, 1980.
C.A.S. (Infor. Sc.)	The University of Pittsburgh, Pittsburgh, Pennsylvania, 1983.
Ph.D.	The Florida State University, Tallahassee, Florida, 1987.

Experience

1977-1978	Medical Librarian, Head of the Department of Library and Free Education, University of Al-Mustansiryiah, Baghdad, Iraq.

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1984-1985	Teaching Assistant, The Florida State University, Tallahassee, Florida.
1986	Librarian, Mayo Correctional Institution, Mayo, Florida.
1986-1987	Information Lab. Assistant, The Florida State University, Tallahassee, Florida.

Professional Associations

1976-	The Iraqi Economists Association.
1977-	The Iraqi Teachers Association.
1984-	The American Society for Information Science.

Scholastic Honors

1978-1984	The Iraqi Ministry of Higher Education and Scientific Research, Scholarship for Advanced Studies in the United States of America.