A STUDY OF THE UTILIZATION OF TRADE MAGAZINES BY MACHINE DESIGNERS IN THE TECHNOLOGY TRANSFER PROCESS: IMPLICATIONS FOR MANAGEMENT

By

DANNY OTTO HOYT

Bachelor of Science

Oklahoma State University

Stillwater, Oklahoma

1970

Submitted to the Graduate Faculty of the
Department of Administrative Sciences of
the College of Business Administration
of the Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
MASTER OF BUSINESS ADMINISTRATION
July, 1975

Name: Danny Otto Hoyt Date of Degree: July, 1975

Institution: Oklahoma State University

Location: Stillwater, Oklahoma

Title of Study: A STUDY TO DETERMINE THE UTILIZATION OF TRADE MAGAZINES BY MACHINE DESIGNERS: IMPLICATIONS FOR MANAGEMENT

Pages in Study: 115 Candidate for Degree of Master of Business Administration

Major Field: Business Administration

Purpose of Study: The general purpose of this study was to determine the utilization of trade magazines by machine designers. The sample was composed of 660 machine designers, all members of the American Society of Mechanical Engineers, representing 60 major organizations. A percentage was used to determine which magazines were most accessible to the designers and which magazines were most often read by the designers. A chi square test was used to determine if there were significant differences in the contents of the four most accessible magazines. A chi square test was also used to determine if various "working" conditions affect which magazines the designers read and which magazines the designers have access to.

Findings and Conclusions: The results of this study revealed that although there are significant differences in the contents of the four magazines, none of them contain adequate useful technical information. The results of the study also revealed that there are several "working" conditions of the designers that affect which magazines the designers read and which ones that they have access to. Several important implications of managements' role in the technology transfer process were revealed.

ADVISOR'S APPROVAL Michael A. Hitt

A STUDY OF THE UTILIZATION OF TRADE MAGAZINES BY MACHINE DESIGNERS IN THE TECHNOLOGY TRANSFER PROCESS: IMPLICATIONS FOR MANAGEMENT

Report Approved:

Michael A. Hitt
Report Adviser

Head, Department of Administrative Sciences

ACKNOWLEDGMENTS

There are a number of people who have helped in the preparation of this report. I would like to thank all those who have been instrumental in the completion of this report.

To Dr. Ralph Catalanello and Dr. Michael Hitt for their criticisms and suggestions throughout the work on this paper.

To Dr. A. H. Soni for the preparation of the questionnaire and without whose technical assistance the report could not have been undertaken.

Finally, an expression of my appreciation to my parents, Mr. and Mrs. James R. Hoyt, for their continuous encouragement in my educational endeavors, and to my wife, Debbie, whose patience, understanding, and sacrifices have been so vital to the realization of this goal.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Figure Page

CHAPTER I

INTRODUCTION

This is a century of technology, and as such, it is marked by a growth and explosion of technical information. Matching this growth in technical information is a rapidly growing scientific and technical population which in the United States, "has doubled from perhaps 300,000 in 1930 to over 600,000 in 1950, and has doubled again to a little less than 1,200,000 today [1968]."[1] Of this scientific and technical population it has been estimated that there are "nearly 100,000 designers today in the United States' industries who are involved in design, analysis and manufacture of machine components and their assembly."[2]

The design engineers in the United States are assisted by several means to promote better utilization of technical information. Some of the typical means for transferring technical information are handbooks, textbooks, trade magazines, technical workshops, conferences organized by professional or academic societies and night and correspondence schools. The literature suggests that with all this technical information, arising from both individual and organizational efforts, that it would be useful to determine how a designer becomes aware of and builds upon the experience of fellow professionals in other fields and in other organizational settings.[3]

Although a knowledge of the use of these information channels is of great importance to an engineering manager, the current literature on

this subject is either too broad in scope for the manager or non-existent. The importance of the technology transfer process to the engineering manager is overwhelming. The enormous beneficial results of a technology transfer process, having a significant influence on society includes the Salk vaccine, jet transportation and the computer. There is a price that must be paid by those not keeping abreast of current events. It is almost certain that companies, and their managers, that do not keep up-to-date on new technology will soon become bankrupt, or at least lose some of their market.[4] The manager is not only responsible to himself and his company for keeping current, but he is also responsible to the community, as there may be a loss of jobs when industrial transformation takes place.

The management of the technology transfer process is not a separate and distinct function of management but rather it is an integral part of management itself. The short-term objective of keeping up on the newest technology is gaining a competitive advantage over those who do not, and the long-term objectives are achieving company growth through expanded product lines, new products, and eventually new markets. These are not only the objectives of a technology transfer program but they are important over-all company objectives, and therefore the function is important to the primary business of the company.[5]

Since the transfer of technology is a function of management as the literature indicates, the engineering manager should be responsible for the transferring of technical information from a source to his designers in a usable form. To perform this function a manager must be knowledgable of the information channels used by the designers.

Some studies have been conducted to evaluate the various information

channels used by designers. Allen (1966)[6] was concerned with the existing channels for communications both within and between the scientific and technological communities that were not performing as well as might be desired. Rosenbloom and Wolek (1970)[7] were concerned with the means by which scientists and engineers in industrial research and development organizations acquire technical information useful in their work and yet unavailable from their own knowledge. Shotwell (1971),[8] studying channels used by Allen (1964),[9] found results differing with respect to the use of literature. Allen (1964) found that the literature was not greatly used and was medicore at best in its effect whereas Shotwell (1971) found that published material was the best source of ideas.

Because trade magazines appear to be in a good position to keep the designer current, because there are disparities in the literature as to the effectiveness of trade magazines, and because the use of trade magazines is important to the manager to help him understand the technology transfer process, it appears that a determination of the "State of the Art" of trade magazines is warranted.

Hoyt (1962), in studying the reading habits of scientists and engineers, found that "there are identifiable differences in the subscription habits of different categories of research and development workers, by academic attainment, by pay level, employment attainment (research, test, or development), and academic discipline (M.E., Chem.E.)."[10] A recent study involving the reading habits of design engineers was conducted at the 1974 Design Engineering Show in Chicago using data from 467 attendees. When asked, "Of the publications that you read regularly, which one offers you the most useful information in your work?", the top three rated magazines were: Machine Design, Design News, and Product

Engineering.[11] Although this audience survey publication is useful in determining the reach and duplication of the magazines, it does not relate the "working" conditions of the designer to the magazines that he reads or has access to. "Working" conditions are variables related to a designer's job (i.e., design responsibility, use of handbook, etc.).

The proposed study will examine the trade magazines commonly associated with design engineers to determine which magazines are most often read by the designers and which magazines are most accessible to the designers. The four most popular magazines will be examined to determine their contents, and the contents will be related to the magazines that the designers read or the magazines that the designers have access to.

The study will examine the "working" conditions of the designers that read the magazines and the "working" conditions of the designers that have access to the magazines. This study will try to show the importance of a knowledge of the "working" conditions of the designers that read or have access to the magazines, the importance of the use of trade magazines in the technology transfer process, and the importance of the process of technology transfer itself to the engineering manager. This is indeed a formidable task, but then so is the challenge of maintaining the high standards set by the United States industries in an ever-changing technical international market.

FOOTNOTES

[1]George A. Steiner and Jack O. Vance, "Selected Papers from a Seminar on the Management of Technology Transfer, UCLA, March 1968-Introduction," IEEE Transactions on Engineering Management, Vol. EM-16, No. 3 (1969), p. 99.

[2]Dr. A. H. Soni and L. A. Torfason, "State of the Art in Machine Design Technology at the Practice Level: An Extensive Study," Proceedings of the 1st Design Technology Conference of ASME, 1973, New York, New York, p. 1.

[3]Richard S. Rosenbloom and Francis W. Wolek, Technology and Information Transfer: A Survey of Practice in Industrial Organizations (Boston: Harvard University, 1970), p. 4.

[4]Steiner and Vance, p. 101.

[5]John R. Moore, "The Technology Transfer Process Between a Large Science-Oriented and a Large Market-Oriented Company--the North American Rockwell, Challenge," IEEE Transactions on Engineering Management, Vol. EM-16, No. 3 (1969), p. 112.

[6]Thomas J. Allen, "The Differential Performance of Information Channels in the Transfer of Technology," (1966) in Factors in the Transfer of Technology by William H. Gruber and Donald G. Marguis, (MIT Press, 1969), p. 137.

[7]Rosenbloom and Wolek, p. 3.

[8]Thomas K. Shotwell, "Information Flow in Research Laboratory," IEEE Transactions on Engineering Management, Vol. EM-18, No. 1 (1971), p. 91.

[9]Allen, p. 145.

[10]J. W. Hoyt, "Periodical Readership of Scientists and Engineers in Research and Development Laboratories," IEEE Transactions on Engineering Management, Vol. EM-9-10 (1962), p. 11.

[11]"1974 Design Engineering Show-Audience Survey and Publication Readership Report" conducted by Exhibit Surveys, Inc. (1974), p. 3.

CHAPTER II

SURVEY OF RELATED LITERATURE

This chapter will give a brief history of trade magazines from the first publication in 1665, through other early publications, to the present-day publications. This history will give the date of the first publications, the purposes of the publications, and some of the typical contents of the publications.

This chapter will also look at some of the literature that evaluates trade magazines as a channel for transferring technical information. Although many articles, magazines, and books are available in the literature, a great deal of attention be given an article by Thomas J. Allen, "The Differential Performance of Information Channels in the Transfer of Technology" and a book by Richard S. Rosenbloom and Francis W. Wolek, Technology and Information Transfer: A Survey of Practice in Industrial Organizations.

This chapter will also bring out some current literature on managements' function related to the technology transfer process. This literature will show that a determination of the "State of the Art" of trade magazines is warranted.

History of Trade Magazines

"The development of the scientific periodical ran parallel to the development of the scientific society, and evolved out of the need of

the scientific community to develop improved methods of communicating new advances to its members. As the number of scientists increased, personal communication between individuals ceased to be a practical method of keeping abreast of current developments, and an alternative channel of communication, which was capable of disseminating an advance to a large audience, was needed."[1]

The first scientific periodical, the Journal des Scavas, first appeared in Paris in 1665. It included reviews of important research and experiments, news of eminent scientists, and book reviews, and this book later turned out to be the model for other European learned academy journals. Other early publications were the Philosophical Transaction of the Royal Society of London (1665), Journal der Physik (1770), which was the first specialized publication, and Philosophical Magazine (1798), which is still read today by engineers with a theoretical basis of their subject.[2]

Mechanic's Magazine (1823) was the first purely mechanical journal to be published in Great Britain, and was established to give mechanics a better acquaintance with the history and principles of the arts that they practice. This magazine contained accounts of new discoveries, inventions and improvements, reports on the state of the art in Great Britain, and can be cited as the predecessor of today's commercially published technical and trade journals.[3]

The first society journal specifically dealing with Mechanical Engineering to be published in Great Britain was the General Proceedings of the Institute of Mechanical Engineers, first appearing in 1847. The Engineer, which has for over one hundred years been one of the practitioner's most valuable sources of information, was founded in 1856, not

"to furnish a dry register of the progress of machinery," but "to represent effectively the industrial activity in which we live, to keep pace with the improvements and developments in all departments of the arts and manufactures which contribute to our material comfort."[4] By the middle of the nineteenth century it had been estimated that almost one thousand scientific and technical journals were being published throughout the world.[5]

As the United States followed Great Britain in the Industrial Revolution, so did the publishing industry in the United States follow that of Great Britain. The first American factory had only been successful for four years when the first United States publication, New York Prices Current, was established in 1795.[6] At first the increase in the number of publications grew slowly, with only a handful in existence during the first quarter of the nineteenth century.

Some of the pioneer publications were: Butcher's and Packer's Gazette (1808), General Shipping and Commerce List (1815), American Journal of Pharmacy (1825), Franklin Institute Journal (1826), and the American Railroad Journal (1837).[7] Of these, only the Franklin Institute Journal (originally, American Mechanic's Magazine) dealt specifically with Mechanical Engineering. This publication was of particular importance during the early part of the nineteenth century because of its descriptions of newly published American patents. This was extremely important because prior to 1843 the United States Patent Office omitted details of claims of patent grants, publishing only the names of the patentees and the title of the patents. The other early important Mechanical Engineering journal to be published in the United States, Scientific American, commenced publication in 1845.

After the Civil War, the trade journal publishing industry paralleled other industries in a period of rapid growth, and by 1900 there were over 800 business publications. Factors influencing the rapid expansion of this industry at the turn of the century included postal rate reductions in 1879 and the rise in importance of the marketing aspects of business.[8] This brought rise to the first society publication in the United States devoted exclusively to Mechanical Engineering, the Transactions of the American Society of American Engineers, first appearing in 1880. This growth has continued, and presently nearly all branches of science and technology are served by one, if not several journals.

Evaluation of Trade Journals

Before the evaluation of trade journals as a channel for the transferring of technical information can be discussed, it will be necessary to discuss the various types of publications. Houghton[9] found that there are three general classes of business publications. These classes are divided according to the purpose for which they are printed and according to the publishers: (1) periodicals published by learned societies and institutions, (2) independent journals published by commercial publishing firms, and (3) house journals published by industrial firms and organizations.[10]

"Periodicals in learned society journals are published papers presented before meetings of the parent body in a publication usually termed 'journal' or 'transactions' or 'proceedings'." These societies usually have a strict editorial policy, as they generally regard themselves as 'gardians of the arts', therefore ensuring that any material

accepted for publication presents an original and worthwhile contribution to the art.[11] The general purpose journal of the American Society of Mechanical Engineers is Mechanical Engineering which, in addition to society news, includes news briefs on engineering developments culled from current journals and reports, features which are likely to be of general interest, and abstracts of technical papers presented at society meetings.[12] There are no specific figures available, but any investigation of association journals reveals that most of them are produced by non-professional editors. Ordinarily, the association's executive secretary produces the magazine as a part of his managerial duties.

The commercially published journals are those 'produced for profits'. Their purpose is to provide a person, a business, an industry, or a specialized profession with vital information. The profits that these publishing firms seek are rarely, if ever, gained completely through subscriptions. The publishers must invariably draw upon revenues from advertisements. Nearly all commercially published journals have advertisements as a regular feature. The articles are usually written by staff technical journalists and tend to be broad in nature.[13]

The house journal is a publication issued by an industrial company or organization to project and enhance the image of the firm. Hence journals are usually made available on a subscription-free basis to potential customers of the company. This type of journal is known as an "external" house journal as they are primarily designed for non-company personnel. The "internal" house publications are designed to promote a "community" type atmosphere in the company. The "internal" house journals are of little value in transferring technical information.[14]

The major distinction between commercially published and society published journals, other than the publishers, is the editorial policy

of each. Because the society publications are committed to the profession, it must admit to certain limitations of editorial freedom, whereas commercially published journals can and do act as critics of an industry when the industry can benefit from criticism.[15]

The great sums of money invested yearly in machines and raw materials used to make the United States the most productive nation in the world are controlled by men that read trade journals. A technological development in any sphere of activity will eventually get to the organizations related to it. "The process of diffusion of technological developments to organizations would itself be an interesting topic for research."[16]

Studies have been conducted to examine the process of diffusion of technological developments to organizations. Allen (1966), Rosenbloom and Wolek (1970), and Soni (1973) have developed studies involving various information channels for transferring technical information. Allen (1966)[17] uses those in Table A, Typical Information Channels; while Rosenbloom and Wolek (1970)[18] used the information channels in Table B, Typical Information Channels; while Dr. A. H. Soni, Oklahoma State University, found that "the best known media for transferring technical information are handbooks, textbooks, trade magazines, technical workshops, conferences organized by professional societies, and attending night and enrolling in correspondence schools."[19]

Many researchers have found that trade magazines do not serve the function of transferring technical information. Firdoia (1968) found that since leaving school, the average engineer has become increasingly specialized in response to the very nature of the tasks on which he works. This specialization is of course reflected in the technical

TABLE A

TYPICAL INFORMATION CHANNELS

Literature	Books, professional, technical, and trade journals and other publically accessible written material.
Vendors	Representatives of, or documentation generated by, supplies or potential suppliers of design components.
Customers	Representatives of, or documentation generated by, the government agency for which the project is performed.
External Sources	Sources outside the laboratory that do not fall into the above three categories. These include paid and unpaid consultants and representatives of government agencies other than the customer agency.
Technical Staff	Engineers and scientists in the laboratory who are not assigned directly to the project being considered.
Company Research	Any other project performed previously or simultaneously in the laboratory regardless of its source of funding.
Analysis and Experimentation	Ideas which are the result of an engineering analysis, test, or experiment with no immediate input of information from any other source.
Personal Experience	Ideas which were previously used by the engineer for similar problems and are recalled directly from memory.

TABLE B

TYPICAL INFORMATION CHANNELS

I. Sources within the respondent's own company:

(A) Interpersonal communication:

(1) Local source- an engineer or scientist employed in the same establishment.

(2) Other Corporate Sources- another person employed by the same corporation.

(B) Written communication:

(3) Documents- any written source originating in the same corporation.

II. Sources outside the respondent's company:

(A) Written communication:

(4) Trade documents- supplier's catalogs, trade magazines, unpublished technical papers, etc.

(5) Professional documents- published books, journal articles, or conference papers.

(B) Interpersonal communication:

(6) External sources- interpersonal communication outside the firm.

papers that he reads and writes. "He rarely makes much of an effort to advance his general technical education and as a result of this, he finds the journals, which contains articles of general interest, are over his head. These journals rate very poorly as information channels in technology as they are usually incomprehensible to the average engineer."[20]

Soni (1973)[21] found some indirect observations concerning trade magazines:

> (A) The existing avenues, such as trade magazines, of updating the technical know-how do not satisfy the designer's needs.
> (B) The quality of the technical material that is presented in the journals and transactions is far beyond the level of understanding of 85% of the designers.
> (C) The management seems to do little to transfer the high quality research material to the designer's desk in a usable form.

Soni's observations add to the beliefs of Allen (1964) and Rosenbloom and Wolek (1970) concerning the inadequacy of trade magazines. Allen found that trade literature was not greatly used and was medicore at best in its performance, while Rosenbloom and Wolek found that scientists tend to make substantially more use than engineers do of sources outside the corporation, a difference which is especially marked in the use of journals and books. Not all the literature agrees on the poor showing of trade magazines. Shotwell (1971) found that the trade literature was the best source of information.

An extensive study by Wood and Hamilton (1967),[22] conducted in Great Britain using 2,500 members of the Institute of Mechanical Engineers, indicates that "within a week before completing the survey, 18.6% of the sample had required exhaustive information on a single topic within their field, 68.8% had required every day information, and 27.5% had

required information from outside the field of Mechanical Engineering."[23] The authors feel that although the information needed is available in the literature, few engineers are equipped to make the best use of the literature. The most obvious explanation of the situation is that the professional training of the engineer is not literature-oriented.[24]

The Wood and Hamilton report demonstrated that "only 11% of the Mechanical Engineers had received any training in the use of technical literature, but of this figure 91% had found the training valuable. On the other hand, 75% of the engineers that had received no training indiciated that they would have welcomed it."[25] An earlier study by the American Institute of Chemical Engineers (1965) pointed out that "engineers are often unaware of sources of information on their subjects, and that there was a pressing need to introduce courses of instruction in the use of literature into the professional training curricula of engineers."[26]

Importance of Technology Transfer Process to Management

The lack of management in the transfer of high quality research material to the designer's desk in a usable form, as mentioned by Soni (1973), is studied by Shotwell (1971),[27] who found that "It has become increasingly more obvious that new managerial and organizational methods and structures must be developed to manage both the old and the new technology for the benefit of mankind."

Although the transfer of technology would probably take place eventually, "overt management steps must be taken to create the environment and provide the tools needed for effective full involvement

TABLE C

(1) There is a wide range of managerial methods and structures that have proved to be effective.

(2) Each organization is unique.

(3) Even in industries where managerial structures are fairly sophisticated, there exists dissatisfaction and a continuous search for better methods.

(4) Better technology transfer emphasizes the man rather than the method or structure--this is to say, the method and structure should be directed towards motivating and permitting the man to effect and improve the technology process.

(5) Management is of great importance in effecting and improving technology transfer:

(a) Management's choice of method and structure
(b) The mere effect of top-management to make lower- and middle-management accountable for the continuous improvement of an operationally effective transfer program.

(6) There is an enormous significance of improved communications among men in making technology transfer more effective.

(7) Key individuals in research organizations, directors and top-management, must not only understand the objectives of the organization but also must be highly sympathetic to their achievement.

(8) Whatever methods and structures are developed by management to bring about better technology transfer, there must somehow be developed in both managers and those responsible for technology transfer an enthusiasm and motivation to do a better job.

received by certain individuals who serve as opinion leaders and who pass the information on to the rest of the group. These men, as compared to the average engineer, are consulted much more frequently for advice and maintain a much higher number of contacts with the technical world outside the organization. They actually take the initiative in the passing out of information and suggest fruitful areas for more research.[35] Another managerial method, presently being used by General Electric, is organizing specific technology transfer activities as a staff function.[36]

Some successful companies employ the following techniques for fostering the transfer of technology:[37]

(1) They establish one technical department to act as the company's 'ears and eyes on the world'. This department is responsible for screening technical literature, ensuring that conferences are attended, and distributing competitive technical information throughout the organization.

(2) They use technically-competent purchasing agents to tap outside technical markets.

(3) They invite vendors to display their technical capabilities.

(4) They maintain a liaison with universities on a regular basis.

All of these methods should increase the likelihood that technical information will be available to help solve problems when it is needed. "If a technology transfer program is founded on such basic principles and concepts, it can become a new asset in the American economy and within the individual companies and industries. It is a minimum prerequisite in the accomplishment of remarkable opportunities for the widest application of today's technological advances that must be

developed if our society is to prosper. To meet this challenge is to compound the benefits already gained in the age of technology explosion."[38]

FOOTNOTES

[1]Bernard Houghton, Mechanical Engineering: The Sources of Information (London: Archon Books and Clive Bingley, 1970), p. 96.

[2]Ibid.

[3]Ibid., p. 97.

[4]Ibid.

[5]R. N. Baird and A. T. Turnbull, Industrial and Business Journalism (Philadelphia: Chilton Co., Book Division, 1961), p. 234.

[6]Ibid., p. 99.

[7]Ibid., p. 234.

[8]Ibid.

[9]Houghton, p. 96.

[10]Ibid., p. 97.

[11]Ibid.

[12]Baird and Turnbull, p. 12.

[13]Ibid., p. 8.

[14]Ibid., p. 11.

[15]Ibid.

[16]Richard H. Hall, Organizations--Structures and Process (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1972), p. 161.

[17]Thomas J. Allen, "The Differential Performance in Information Channels in the Transfer of Technology," 1966, in Factors in the Transfer of Technology by William H. Gruber and Donald G. Marguis (MIT Press, 1969), p. 140.

[18]Richard S. Rosenbloom and Francis W. Wolek, Technology and Information Transfer: A Survey of Practice in Industrial Organizations (Boston: Harvard University, 1970), p. 36.

[19]A. H. Soni and L. Torfason, "State of the Art in Machine Design Technology at the Practice Level: An Extensive Study," Proceedings from the 1st Design Technology Conference of ASME, New York, New York (1973), p. 1.

[20]Firdoia, "The Technological Gate-Keepers and Their Role in R & D Laboratories" (MIT Press: MS Thesis, 1968), in Thomas K. Shotwell, "Information Flow in Research Laboratories," IEEE Transactions on Engineering Management, Vol. EM-18, No. 1 (1971), p. 32.

[21]Soni, p. 31.

[22]D. N. Wood and L. Hamilton, "The Information Needs of Mechanical Engineers" (London: Library Association, 1967), in Mechanical Engineering: The Sources of Information (London, 1970), p. 11.

[23]Ibid.

[24]Ibid.

[25]Ibid.

[26]R. A. Davis, "How Engineers Use Literature," Chemical Engineering Progress, 61 (3), (1965), p. 30.

[27]Shotwell, p. 33.

[28]W. Eugene Giberson, "Management of Technology Transfer in an Advanced Project--The Case of Surveyor," IEEE Transactions on Engineering Management, Vol. EM-16, No. 3 (1969), p. 129.

[29]George A. Steiner and Jack O. Vance, "Selected Papers from a Seminar on the Management of Technology Transfer, UCLA, March, 1968," IEEE Transactions on Engineering Management, Vol. EM-16, No. 3 (1969), p. 99.

[30]Giberson, p. 129.

[31]Steiner and Vance, p. 99.

[32]Herman Bieber, "Technology Transfer in Practice," IEEE Transactions on Engineering Management, Vol. EM-16, No. 4 (1969), p. 146.

[33]G. H. Cloud and W. T. Know, "Information Research--A New Tool," Fifth World Petroleum Congress, Paper #15, in John M. Stewart, "Techniques for Technology Transfer Within a Business Firm," IEEE Transactions on Engineering Management, Vol. EM-16, No. 3 (1969), p. 107.

[34]Firdoia, p. 32.

[35]Cloud and Know, p. 107.

[36]Bieber, p. 146.

[37]Stewart, p. 107.

[38]John R. Moore, "The Technology Transfer Process Between a Large Science-Oriented and a Large Market-Oriented Company--The North American Rockwell, Challenge," IEEE Transactions on Engineering Management, Vol. EM-16, No. 3 (1969), p. 115.

CHAPTER III

RESEARCH DESIGN

The purpose of this study is to determine the "State of the Art" of trade magazines used by machine designers. This will be done by the answering of several research questions. To answer these questions, a survey was conducted of machine design engineers. This chapter will describe the sampling procedure used to determine the sample population, it will analyze the questionnaire used to obtain responses from the population, and it will describe the methods used to analyze the data.

Sample[1]

It is believed that there are approximately 100,000 designers[2] today in United States industries who are involved in design, analysis, and manufacture of machine components and their assembly. The major industries employing designers are the automotive industry, textiles, agriculture, packaging, printing, transportation, and materials handling. To select a representative sample of designers to answer the questionnaire is by no means a simple task. A shotgun approach to a group of designers may have chaotic results. For the purpose of selecting a good sample, approximately 2,000 top-level engineering administrators, who are members of the American Society of Mechanical Engineers, were contacted to assist in procuring responses to the questionnaire. The data collected are from a sample of 660 designers,

representing 60 major companies. Based on the assumption that there are 100,000 designers, this sample will represent 0.66% of the design population. This data was obtained with the assistance of Dr. A. H. Soni, Oklahoma State University, with financial assistance from the National Science Foundation (Grant GK 36624).

Questionnaire Design[3]

Appendix A presents the questionnaire used to survey the respondents to determine the "State of the Art" of trade magazines used by machine design engineers. The questionnaire was designed by Dr. A. H. Soni, Professor of Mechanical Engineering, Oklahoma State University, with the assistance from W. W. Mountsier, Mr. K. Urion, and Dr. D. Tao. To help meet the objectives of this study, the questionnaire is divided into several parts:

Part I : Information on the designer's background and his level of involvement in the organization.
(Questions 1-10)

Part II : Designer's general assignment, his methodology, and his tools.
(Questions 11-21)

Part III : Specifics of the designer's assignments and his methodologies.
(Questions 22-43)

Part IV : Designer's involvement in performing different tasks.
(Questions 44-53)

Part V : Designer's technical resources [at his disposal] and their adequacy.
(Questions 54-71)

Part VI : Designer's view of the "State of the Art" in machine design.
(Questions 72-81)

Part VII : Designer's response to the development, availability, and introduction to specialized handbooks.
(Questions 92-94)

Part IX : A partial list of trade magazines commonly associated with machine design.

Method of Data Analysis

The length and complexity of the data in this study deems it necessary to analyze the data in sections. The first section will be concerned with the magazines themselves, the second section will be concerned with an analysis of the responses of those that read the magazines, and the third section will be concerned with an analysis of the responses of those that have access to the magazines, but who do not read them. The results of these three sections will be tabulated in the final chapter, Discussion and Conclusions, in order that general conclusions can be made.

Section I

This section of the data analysis will involve the list of trade magazines from Part IX of the questionnaire. The designers were asked to check ( ) the trade magazine(s) that they have access to and to put an (X) on the magazine(s) to which they often refer (read). An ordinal scale will be used to rank the magazines according to the number of designers that have access to them. The number one magazine will be the

one that the most designers have access to. After the magazines are ranked by 'access', the ratio of the number of designers with access to the magazine/the number of designers in the sample will be calculated. Also, the ratio of the number of designers that read the magazines/the number of designers in the sample will be calculated. The results of the ranking of the magazines by 'access' will be presented in Table I, while the ratios of those with access and that read/the sample will be presented in graphical form in Table II.

The top four magazines will be analyzed to determine their exact contents. A page-by-page analysis of each magazine will be the method employed to determine the number of pages devoted to the following classes: Technical, Non-Technical, or Advertising. This will be done for each of the four magazines for approximately a three-year period.

The Technical category will involve pages of a technical nature that could aid the designer in the design of machine components. These components will be such as to correspond to those in Part III of the questionnaire: Gears, Linkages, Cams, Power Drive, Fasteners, Seals, Springs, Bearings, Electromechanical Components, and Fluid and Pneumatic Equipment.

The Non-Technical category will be sub-divided into Trends & New Products, Informative, and Miscellaneous. Trends & New Products will be used for pages devoted to information would would help the designer broaden his knowledge of what is going on around him in the design field, but is too general in nature to be of much help in the designing of components. The Informative classification will be used for pages of material that are good reading for the designer, but that are found in in a number of other 'reading' magazines (i.e. Reader's Digest). The

Miscellaneous classification will be used for pages that are used to establish a format for the magazines, or pages, other than advertising, that would not fit into the other categories. The Advertising classification will be used for pages used to promote a particular product, a particular class of products, or even a particular industry.

After this data is collected and tabulated, it will be analyzed using a chi-square test to test for dissimilarities among the magazines. A chi-square test will be conducted on (1) Technical pages, (2) Non-Technical pages, and (3) Over-All pages (Technical, Non-Technical and Advertising).

Section II

This section will analyze the responses of the designers who read the magazine to certain questions from the questionnaire in Appendix A. Not all the questions from the questionnaire will be analyzed, but rather only those that are directly or approximately related to the purpose of this study.

The questions to be analyzed will be those dealing with the frequency that designers are called upon to design various components (Questions 22-31) and those dealing with the adequacy of design information for the various components (Questions 72-81). Questions dealing with the "working" conditions of the design (Questions, 3, and 5) as well as those dealing with various methods of up-dating the designer's technical knowhow (Questions 68-70, 83-86, and 90) and those dealing with additional sources of technical information (Questions 56, 61, and 66) will be analyzed. In addition to these questions, those involved either directly (Question 71) or those indirectly (Questions 36 and 37)

with advertising being analyzed.

A chi-square test will be employed to determine if there are significant differences among the magazines that the designers read and their responses to the questions.

Section III

This section of the data analysis will involve the analysis of the responses of the designers who have access to the magazines, but do not read them. The same questions will be examined in this section as were examined in Section II. A chi-square test will be employed to determine if there are any significant differences among the magazines that the designers have access to, but do not read, and their responses to the questions. For clarification, the term 'access' will mean having the magazine available but not reading it.

The results of the three sections will be tabulated and grouped together in the final chapter to help in drawing general conclusions, in addition to some specific conclusions that can be drawn from the analysis of each question.

Research Questions

The main purpose of this study is to determine the "State of the Art" of trade magazines used by machine design engineers. This will be done by answering the following research questions:

(1) Which magazines are most accessible to machine designers?

(2) Which magazines are most often read by machine designers?

(3) Is there significant differences in the contents of the magazines?

(4) Do various "working" conditions have an effect on which magazines a designer reads?

(5) Do various "working" conditions have an effect on which magazines a designer has access to?

The answers to these research questions will determine the "State of the Art" of trade magazines used by machine designers.

FOOTNOTES

[1]Dr. A. H. Soni and T. A. Torfason, "State of the Art in Machine Design Technology at the Practice Level: An Extensive Study," Proceedings of the 1st Design Technology Conference of ASME, 1973, New York, New York, p. 1.

[2]Ibid.

[3]Ibid.

CHAPTER IV

DATA ANALYSIS

With the exception of the ranking of the magazines in Section I of Data Analysis, the statistical analysis to be used to test for significant differences among the responses to the questions and to test for significant differences among the contents of the magazines will be the chi-square test. The use of this "homogeneity" test permits an identification of the oddities and also gives a direction to the oddities. A significance level of .10 will be used because of the large sample size involved. The following will be the method used to indicate the level of significance for each test: .001(****), .01(***), .05(**), and .10 (*), and tests that show no statistical significance will not have any asterisks after the calculated chi-square value.

All of the response data and the data concerned with the contents of the magazines will be presented in the form of three-dimensional charts. The axes of the charts will be the magazines that the designer reads (or has access to), the responses to the questions, and the percentage for each response. In the case of the analysis of the magazines, the axes will be the magazines, the contents of the magazines, and the percentage of the contents.

Section I will show the rankings of the magazines by 'access' and also will present the ratios of the number of designers that have access to the magazines/total number of designers in sample in graphical

form. The section will also analyze the contents of the magazines.

Section I

The results of the ranking of the magazines by 'access' are presented in Table I. The ratios of the number of designers with access to the magazines/the sample population are presented in Table II. The top four magazines are Machine Design, Design Engineering, Mechanical Engineering, and Product Engineering. From this point on these magazines will be referred to by the following abbreviations: Machine Design(MD), Design Engineering(DE), Mechanical Engineering(ME), and Product Engineering(PE).

The four magazines were analyzed, using a page-by-page analysis, to determine the exact contents of the magazines. This was done for approximately a three year period. The pages were classified as being technical, non-technical, or advertising.

Figure 1 presents data on the Technical contents of the magazines. It may be noted that 40% of DE's technical pages are devoted to fluid power design, while 20% of those of MD and PE are, while only 10% of ME's technical pages are used for the design of fluid power equipment. 12% of DE's technical pages are used for electromechanical components, while 9% of ME's, and 5% of MD and PE are. About 10% of MD, DE, and PE's pages are used for power drive, while only 3% of ME's pages are used for this component. All of the magazines devoted about 7% of their technical pages to the designing of bearings. PE devoted over 7% of its technical pages to the design of fasteners, while the other magazines had very little on the design of this component. The other design companies received little attention in the magazines. The homogeneity test shows that chi square equals 255.86**** with 30 degrees of freedom.

TABLE I

MAGAZINES RATED BY 'ACCESS'

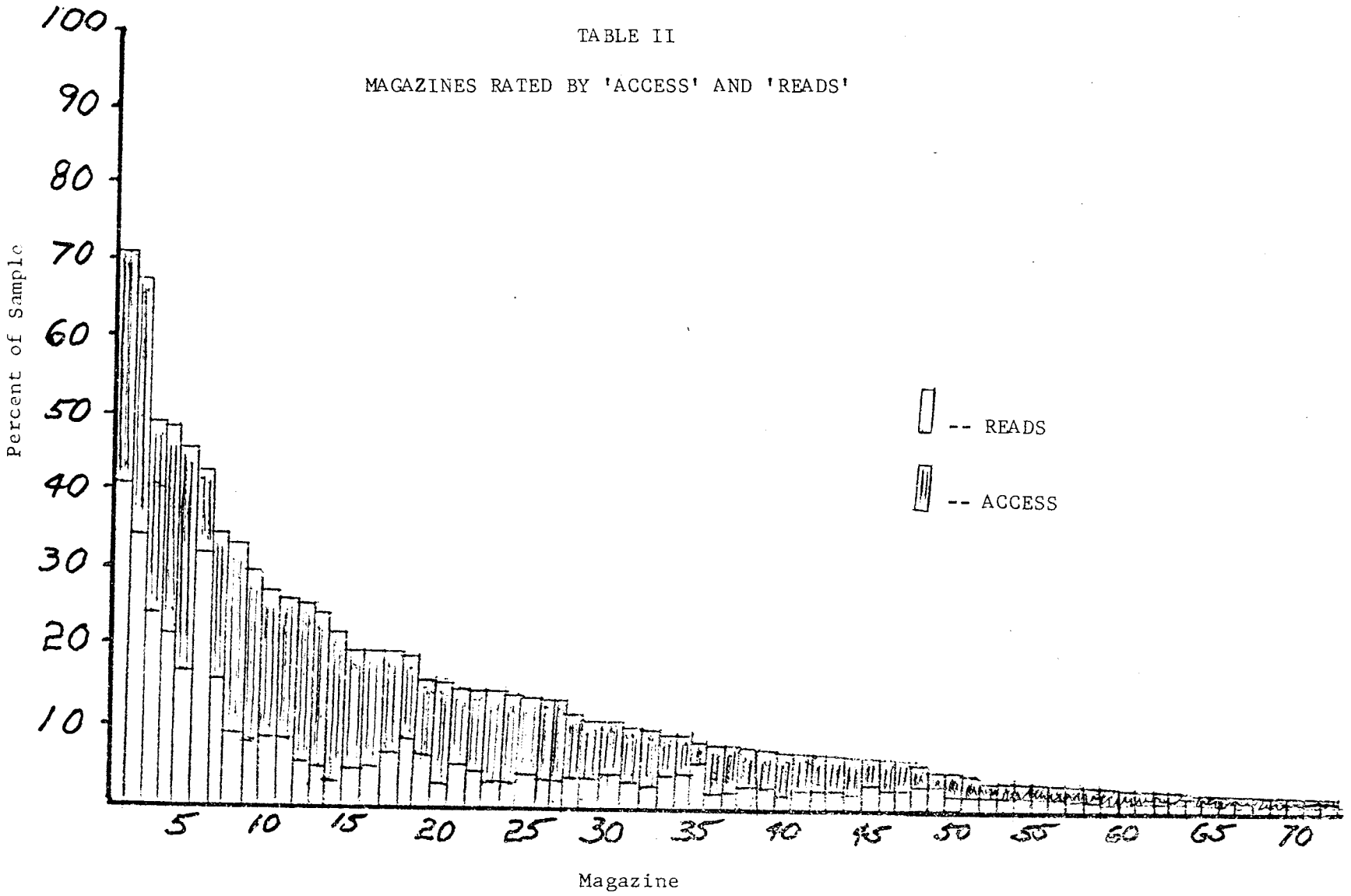
1. Machine Design
2. Design Engineering
3. Mechanical Engineering
4. Product Engineering
5. Materials Engineering
6. Others
7. Industrial Equipment News
8. American Machinist
9. Control Engineering
10. Hydraulics and Pneumatics
11. Machinery
12. Scientific American
13. Professional Engineer
14. Chemical and Engineering News
15. Mechanism and Machine Theory
16. ASME Journals
17. Fasteners
18. Instruments and Control Systems
19. Aviation Week and Space Technology
20. Lubrication Engineering
21. Electro-Mechanical Design
22. Automotive Industries
23. Tooling and Production
24. Manufacturing Engineering of Management
25. SAE Automotive Engineering
26. Metal Finishing
27. Welding Engineer
28. American Scientist
29. Foundry
30. Modern Metals
31. Abrasive Engineering
32. ASHRAE Journal
33. Metal Progress
34. Journal of Metals
35. Sound and Vibration
36. Precision Metal
37. Electroplating and Metal Finishing
38. Heating, Piping and Air Conditioning
39. Fluid Power International
40. Modern Castings
41. Consulting Engineer
42. Astronautics and Aeronautics
43. Rubber World
44. Springs
45. Journal of Science and Technology
46. Materials Science and Engineering
47. Ordnance
48. Corrosion Prevention and Control
49. Heat Engineering

TABLE I - Continued

50. Anti-Corrosion
51. Journal of Petroleum Technology
52. Plating
53. Chartered Mechanical Engineers
54. Rubber Journal
55. Materials Evaluation
56. Materials Protection and Performance
57. Nuclear Engineering
58. Engineering Education
59. Industrial Lubrication and Tribology
60. Others
61. Fluidics Feedback
62. Pipe Line Industry
63. Traffic Engineering Control
64. Midwest Engineer
65. Pipe Line News
66. Mineral Digest
67. Oklahoma Professional Engineer
68. Tire Review
69. Spaceflight
70. Space World
71. Hovering Craft and Hydrofoil
72. Southern Automotive Journal

TABLE II

MAGAZINES RATED BY 'ACCESS' AND 'READS'



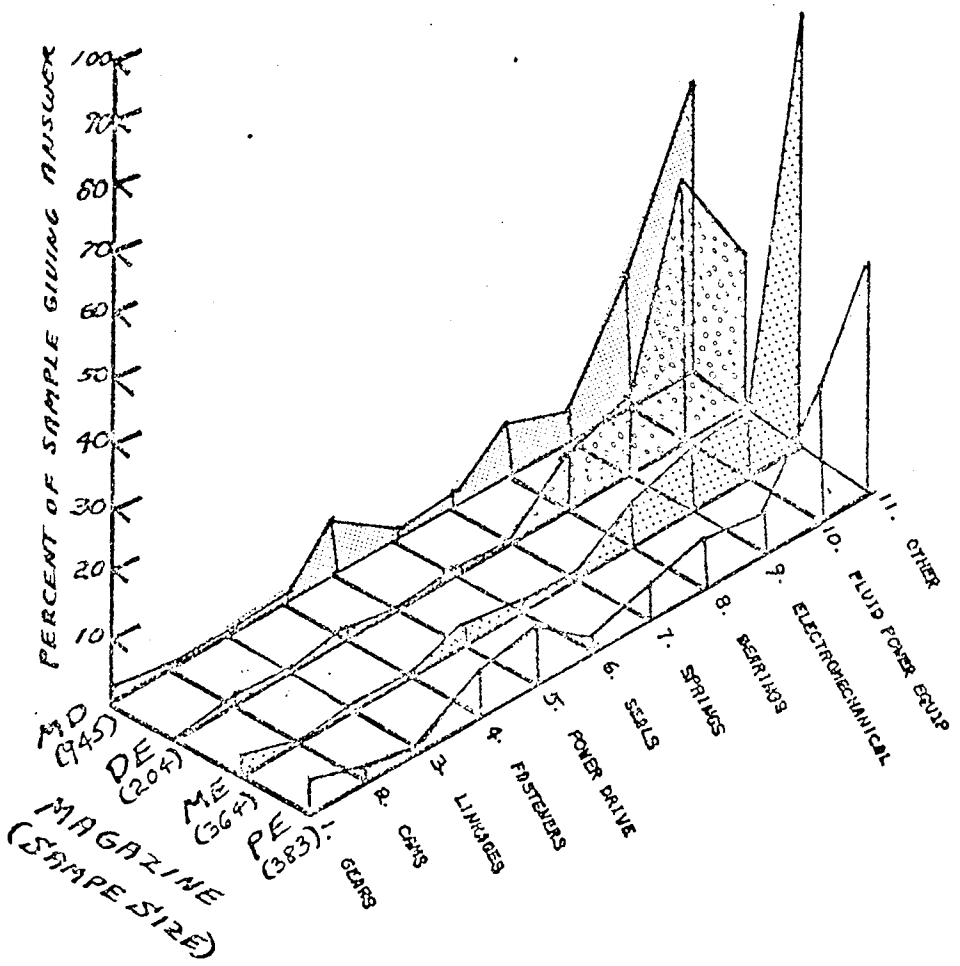


Figure 1. Technical Contents

Figure 2 presents data on the Non-Technical contents of the magazines. Nearly 50% of ME's non-technical pages are used for Miscelaneous purposes, while 30% of DE, 17% of PE, and only 7% of MD's non-technical pages, 50% of MD, 33% of DE, 25% of PE, and 20% of ME are used for Informative purposes. The homogeneity test shows that chi square equals 1461.60**** with 6 degrees of freedom.

Figure 3 presents data on the Over-all contents of the magazines.

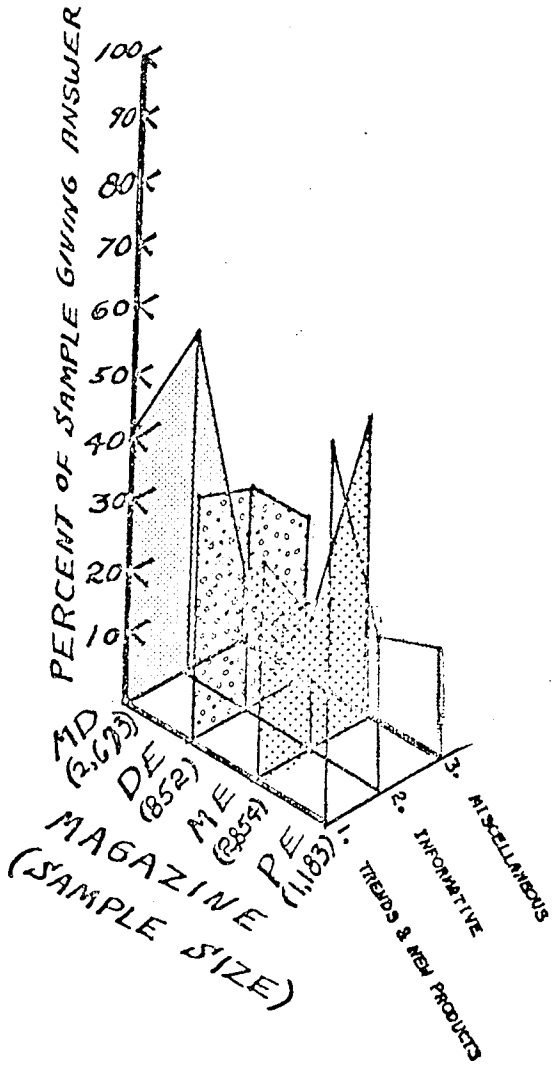


Figure 2. Non-Technical Contents:

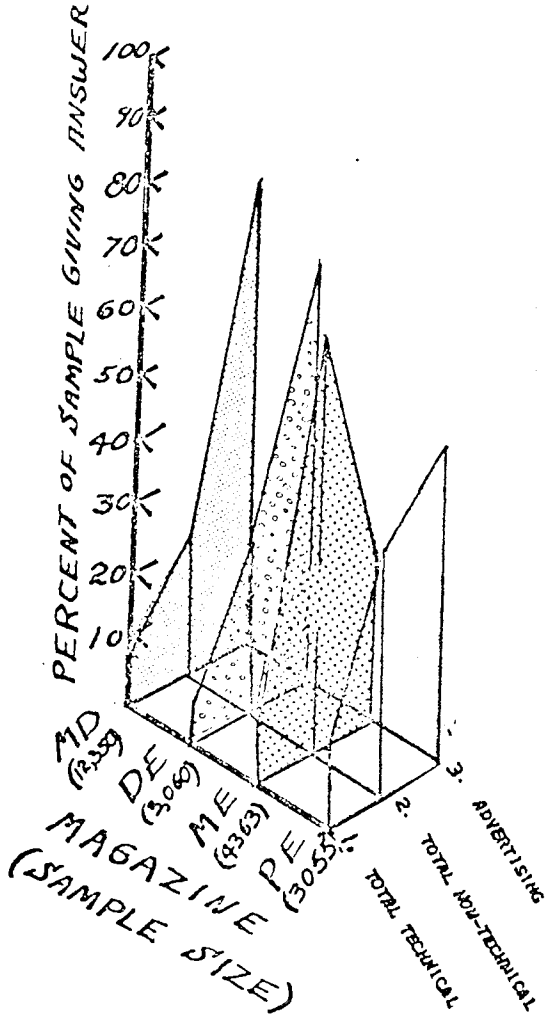


Figure 3. Over-All Contents:

It is interesting to note that 70% of MD is used for advertising purposes, as are 65% of DE, 49% of PE and 26% of ME. It is also interesting to note that MD, DE, and ME devote only 8% of their magazines to technical material, while 13% of PE is used for this purpose. The homogeneity test shows that chi square equals 3173.74**** with 6 degrees of freedom.

This section of the data analysis presented the results of the rankings of the magazines by 'access' (Table I) and the ratios of the designers that read or have access to the magazines/total sample (Table II). The top four magazines, Machine Design, Design Engineering, Mechanical Engineering, and Product Engineering, were analyzed and found to have different emphasis as to the contents of the magazines. The importance of this findings will be discussed in the final chapter, Discussion and Conclusions.

Section II will analyze several "working" conditions of the designers that read the magazines. When a figure is referred to, the question that the responses answer from the questionnaire in Appendix A, the question number will be given in parenthesis.

Section II

Results

Figure 4 (Question 2) presents the responses to the question on what design responsibility of the designer is. It may be noted that 62% of the readers of MD and DE are involved in the design of mechanisms, while 55% of the readers of PE and 44% of the readers of ME are involved in the design of mechanisms. 16% of the readers of ME are involved with stress, while only 9% of PE readers, 8% of MD readers, and 7% of DE readers are involved in this area of design. The homogeneity test shows

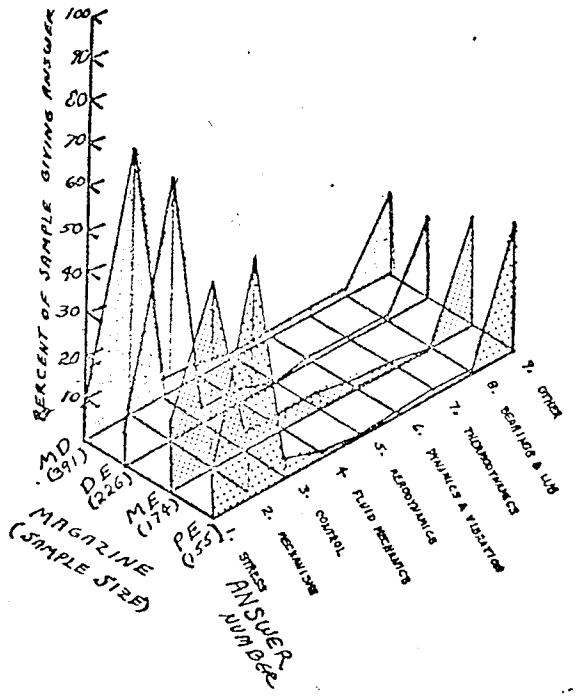


Figure 4. Design responsibility where most of designer's time is spent:

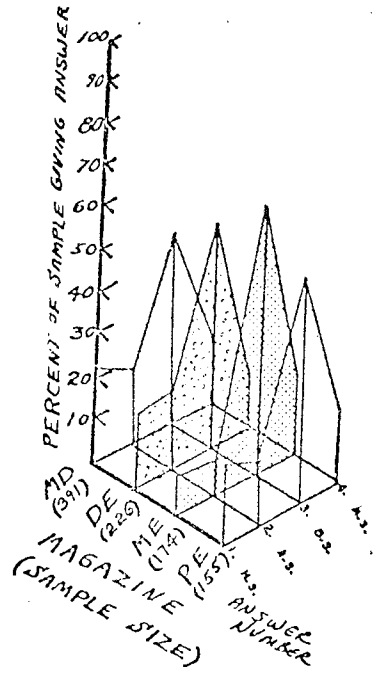


Figure 5. Formal Education:

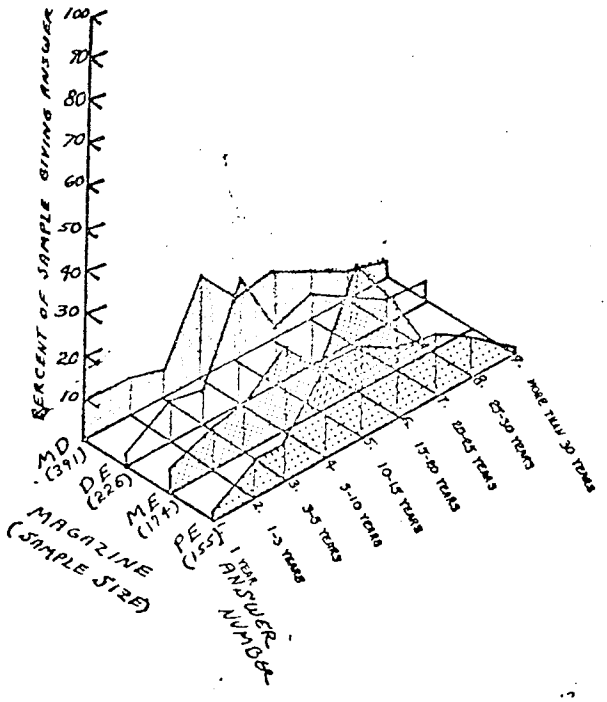


Figure 6. Total time you have worked in design:

that chi square equals 49.64*** with 24 degrees of freedom.

Figure 5 (Question 3) presents data on the question of the formal education of the designer. It may be noted that less than 10% of ME readers have a HS degree, while DE has 17%, PE has 19%, and MD has 21% of their readers with HS degrees. It is interesting to note that nearly 83% of the readers of ME have a BS degree or higher, while PE, DE, and MD have 67%, 64%, and 51%, respectively, with a BS or higher. The homogeneity test shows that chi square equals 29.29**** with 9 degrees of freedom.

Figure 6 (Question 5) presents data that shows the length of time that the designer has worked in that field. 10% of the readers of MD have worked in the field for 1 year or less, and 25% of these readers have been in design 5 years or less. Only 16% of the readers of PE have been in design for 5 years or less, with only 2% of the readers with 1 year or less. 11% of PE readers have been in design for 25 years or more, as have 11% of MD and DE readers, but none of the readers of ME have more than 25 years of design. The homogeneity test shows that chi square equals 59.41**** with 24 degrees of freedom.

Figure 7 (Question 22) presents the data showing the frequency that designers design Gears. 50% of all of the designers seldom or never design gears. The readers of MD and DE design gears slightly more often than the readers of ME and PE. Gears are designed at least once every three months by 25% of the readers of MD and DE, while 21% of the readers of ME and 18% of the readers of PE design gears that often. The homogeneity test shows that chi square equals 16.5 with 21 degrees of freedom.

Figure 8 (Question 23) presents the data showing the frequency

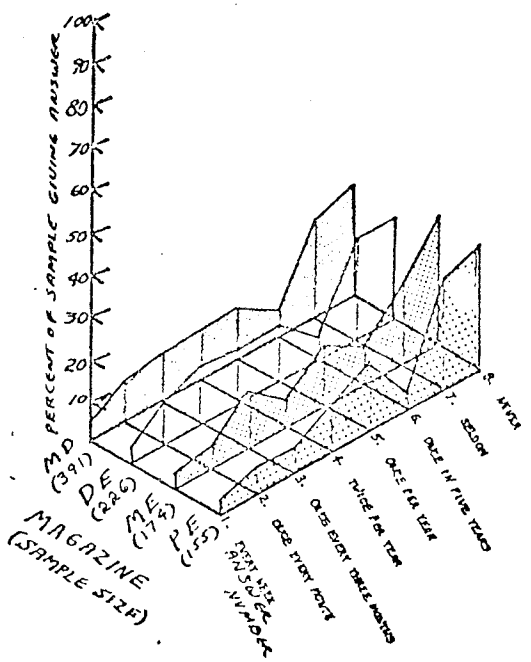


Figure 7. How frequently do you design Gears:

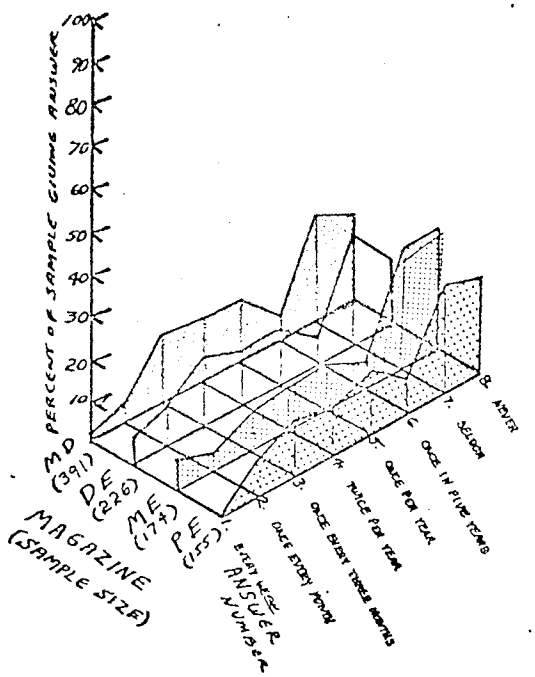


Figure 8. How frequently do you design Cams:

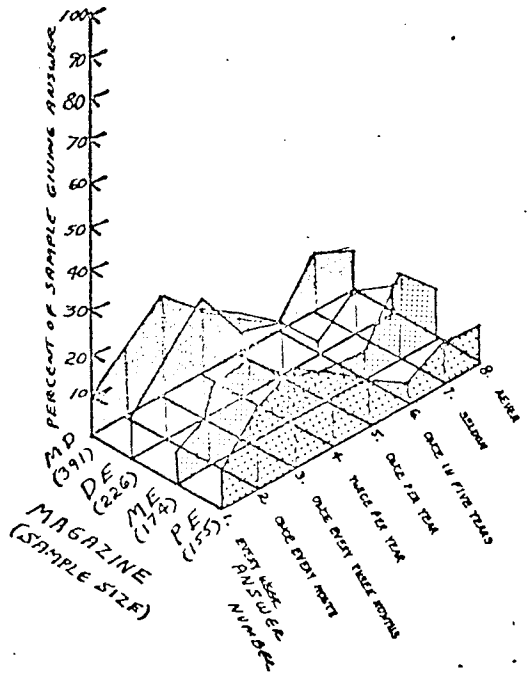


Figure 9. How frequently do you design Linkages:

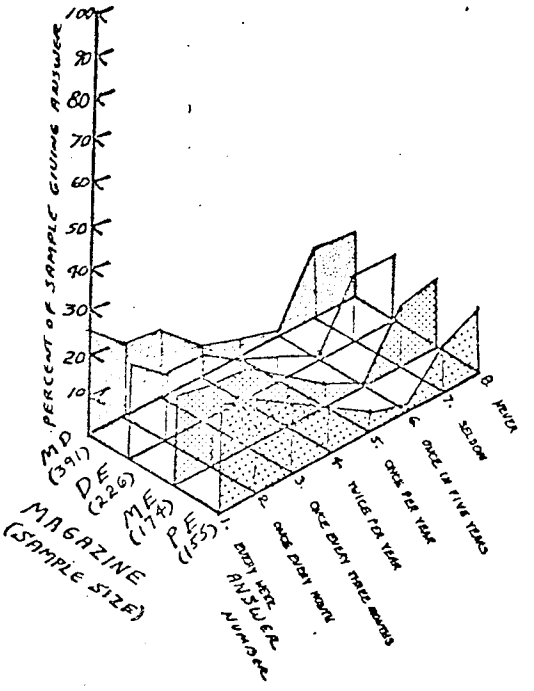


Figure 10. How frequently do you design Fasteners:

that designers design Cams. 30% of the readers of DE design cams at least once every three months, while 20% of the readers of MD, DE, and PE design cams with that frequency. It is also interesting to note that 55% of the readers of ME seldom or never design cams, while 46% of PE readers, 44% of MD readers, and 41% of DE readers seldom or never design cams. The homogeneity test shows that chi square equals 38.11*** with 21 degrees of freedom.

Figure 9 (Question 24) presents data on how often designers design linkages. 56% of the readers of DE design linkages at least once every three months, while 51%, 48%, and 44% of MD, PE, and ME readers, respectively, design linkages that often. 31% of ME readers seldom or never design this component, while 20% of MD readers, 18% of PE readers, and 14% of DE readers seldom or never design linkages. The homogeneity test shows that chi square equals 26.34 with 21 degrees of freedom.

Figure 10 (Question 25) presents data on the frequency that designers design fasteners. Over 55% of all the readers design fasteners at least once every three months and nearly 25% of them design fasteners at least once a week. 25% of the readers seldom or never design fasteners. The homogeneity test shows that chi square equals 8.20 with 21 degrees of freedom.

Figure 11 (Question 26) presents data on how often the designer designs power drive. Only 33% of the readers of ME design power drive at least once every three months, while nearly 40% of MD, DE, and PE readers design power drive components that often. 25% of the readers of MD, DE, and ME seldom or never design this component, while 20% of PE readers seldom or never design power drive. The homogeneity test shows that chi square equals 11.31 with 21 degrees of freedom.

Figure 12 (Question 27) presents data on the frequency that designers design Seals. 35% of the readers of each magazine designs seals at least once every three months, while 38% of the readers of each magazine seldom design seals. 8% of the readers of DE design seals at least once a week, while 5% of both MD and ME readers and only 3% of PE readers design seals that often. The homogeneity test shows that chi square equals 9.54 with 21 degrees of freedom.

Figure 13 (Question 28) presents data on the frequency that designers design springs. Nearly 40% of the readers of the magazines design springs at least once every three months, while only 22% of the readers seldom or never design springs. The homogeneity test shows that chi square equals 11.31 with 21 degrees of freedom.

Figure 14 (Question 29) presents data on how often the designer designs bearings. 44% of the readers of MD and ME design bearings at least once every three months, while only 37% of the readers of DE and PE design bearings with that frequency. About 34% of the readers seldom or never design bearings. The homogeneity test shows that chi square equals 18.41 with 21 degrees of freedom.

Figure 15 (Question 30) presents data on the frequency that designers design electromechanical components. 30% of the readers of MD, ME, and PE design electromechanical components at least once every three months, while 39% of the readers of DE design these components at least once every three months. 42% of the readers of MD, ME, and PE seldom or never design electro-mechanical components, while only 36% of the readers of DE seldom or never design these components. The homogeneity test shows that chi square equals 11.34 with 21 degrees of freedom.

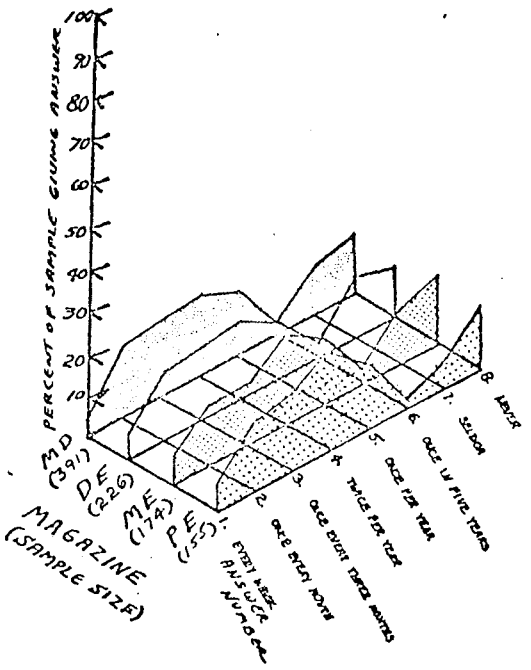


Figure 11. How frequently do you design Power Drive:

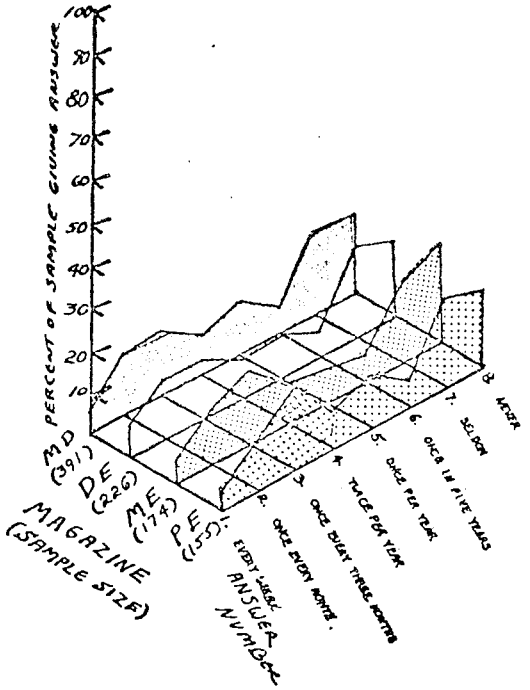


Figure 12. How frequently do you design Seals:

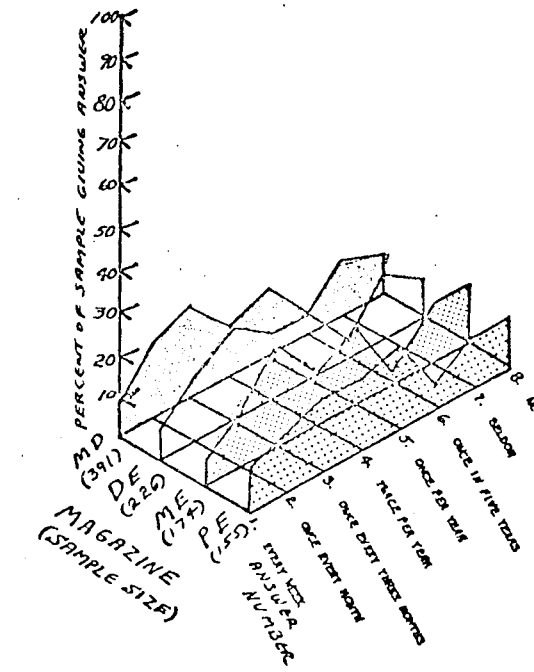


Figure 13. How frequently do you design Springs:

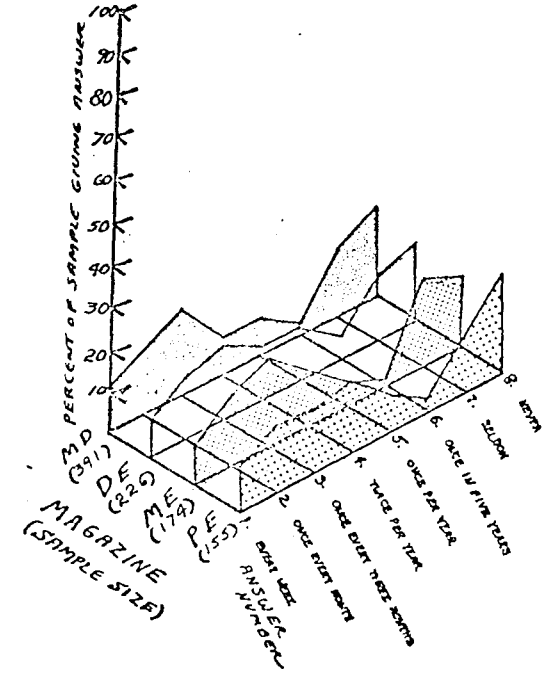


Figure 14. How frequently do you design Bearings:

Figure 16 (Question 31) presents data on how often the designer designs fluid power and pneumatics. 27% of the readers of MD design fluid power equipment at least once every three months, while 30% of the readers of ME and PE and 38% of the readers of DE design this equipment that often. 47% of the readers of MD, ME, and PE seldom or never design this equipment, while only 40% of the readers of DE seldom or never design fluid power and pneumatic equipment. The homogeneity test shows that chi square equals 20.85 with 21 degrees of freedom.

Figure 17 (Question 36) presents the data on the question of how often designers use commercially available components. 55%, 54%, and 53% of the readers of PE, MD, and ME, respectively, use commercially available components always or mostly, while 46% of the readers of DE use the available components that often. 8% of the readers of MD, ME, and PE seldom or never use the commercially available components, while 17% of the DE readers seldom or never use them. The homogeneity test shows that chi square equals 19.09* with 12 degrees of freedom.

Figure 18 (Question 37) presents the data on the question of having other companies manufacturing special components. Over 53% of the readers of ME and PE always or mostly have other companies manufacture special components, while only 8% of the readers of these magazines seldom or never have them made by other companies. On the other hand, 17% of the readers of MD and 15% of the DE readers always or mostly have these components made, while 28% of these readers seldom or never have other manufacturers make their special components. The homogeneity test shows that chi square equals 132.66**** with 12 degrees of freedom.

Figure 19 (Question 56) presents the data on how many handbooks the designers use. Over 95% of all the readers use two or more handbooks

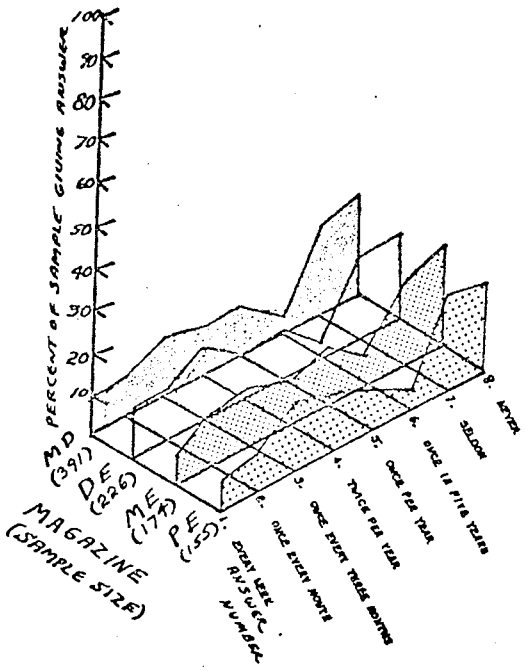


Figure 15. How frequently do you design Electromechanical Components:

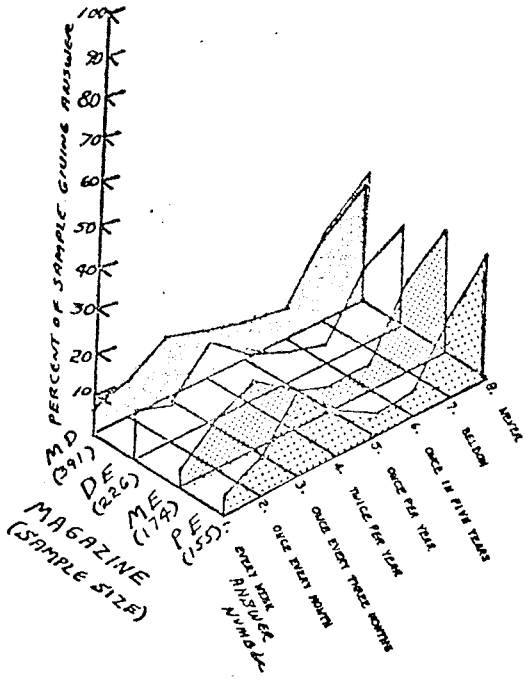


Figure 16. How frequently do you design Fluid Power Equipment:

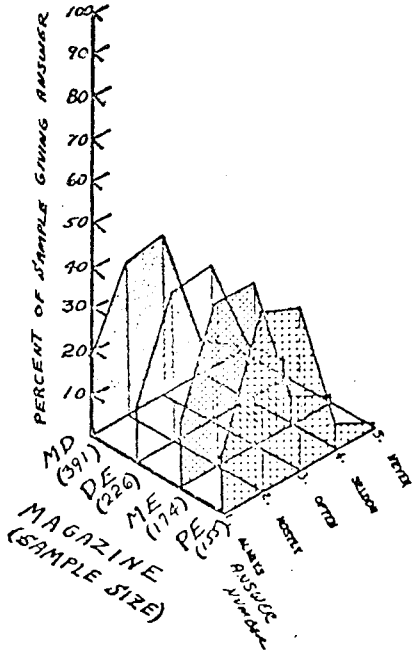


Figure 17. Do you use commercially available components:

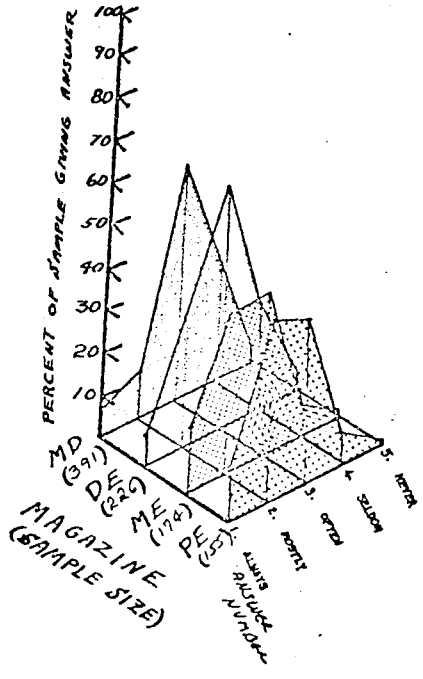


Figure 18. Do you have other companies manufacture special components:

to assist them in their work. It is interesting to note that 22% of DE readers use 20 or more handbooks, while only 13% of MD and PE readers and 9% of ME readers use that many. The homogeneity test shows that chi square equals 28.50 with 24 degrees of freedom.

Figure 20 (Question 61) presents the data on the question of how many textbooks the designers use. 39% of DE readers use 3 textbooks or less, while only 32% of MD readers, 29% of PE readers, and 24% of ME readers use 3 textbooks or less. About 15% of all the readers use 4 or 5 textbooks. Only 42% of the readers of DE use 6 or more textbooks, while 53% of both MD and PE, and 58% of ME readers use 6 or more. It is interesting to note that 11% of the DE readers use no textbooks at all, while all of the readers of PE use at least one textbook. The homogeneity test shows that chi square equals 41.08*** with 24 degrees of freedom.

Figure 21 (Question 66) presents data on the question of how many company standards the designer uses. 40% of MD readers and 43% of PE readers and 47% of DE and ME readers use three or less company standards, while 43% of DE readers, 45% of ME readers, and 48% of both MD and PE readers use six or more company standards. The homogeneity test shows that chi square equals 19.41 with 24 degrees of freedom.

Figure 22 (Question 68) presents data on the question of how often the designer reads technical papers in all fields. Less than 8% of all the readers of the four magazines always or nearly always read technical papers in all fields, while 72% of PE readers, 71% of MD readers, 67% of ME readers, and only 59% of DE readers seldom or never read these papers. The homogeneity test shows that chi square equals 12.13 with 12 degrees of freedom.

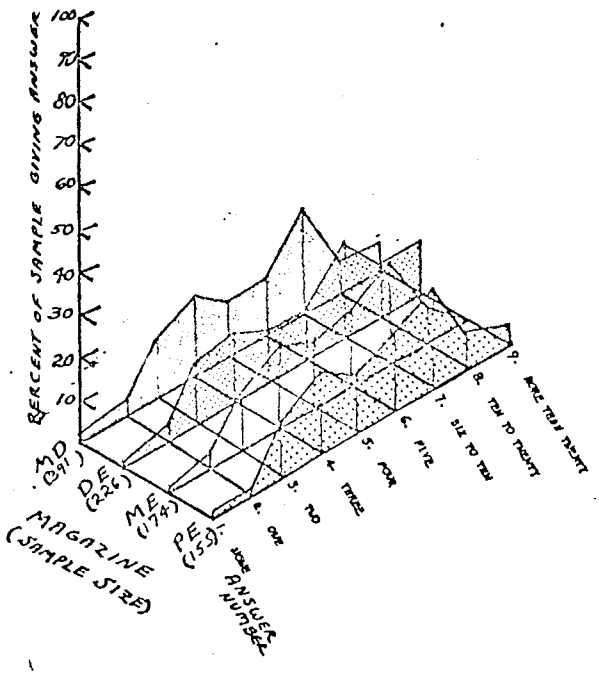


Figure 19. How many handbooks do you use:

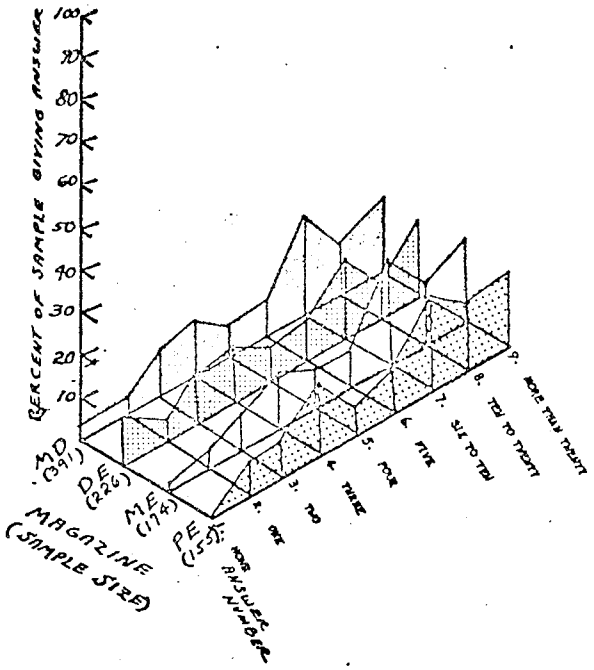


Figure 20. How many textbooks do you use:

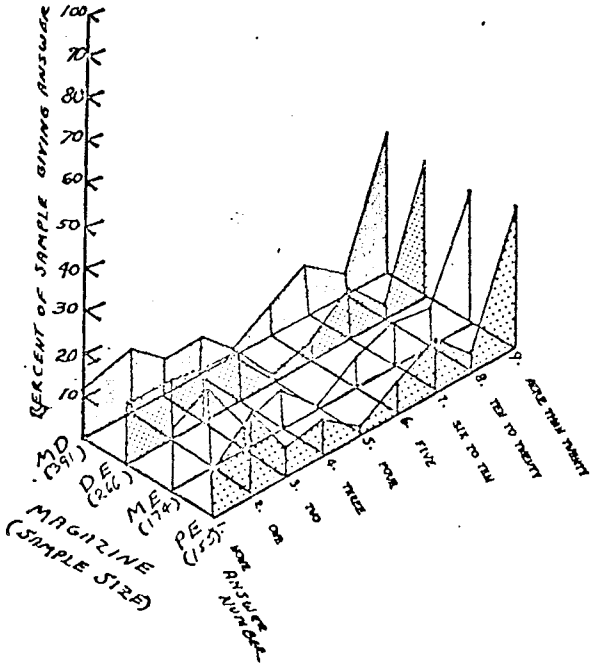


Figure 21. How many company standards do you use:

Figure 23 (Question 69) presents data on the question of how often the designer reads technical papers that he is interested in. Nearly 50% of all the readers always or nearly always read technical papers that they are interested in; 52% of DE readers, 49% for ME readers, 48% for DE readers, and 44% for MD readers. Less than 10% of all the readers seldom or never read technical papers in which they have an interest. The homogeneity test shows that chi square equals 14.38 with 12 degrees of freedom.

Figure 24 (Question 70) presents data on the question of how often the designer reads technical papers related to his work. 59% of the readers of DE and ME, 57% of the readers of PE, and 53% of the readers of MD either always or nearly always read technical papers related to his work, while only 6%, 5%, 3%, and 2% of MD, DE, PE, and ME, respectively, seldom or never read these papers. The homogeneity test shows that chi square equals 10.65 with 12 degrees of freedom.

Figure 25 (Question 71) presents data on the question of how often the designer reads advertising when reading trade publications. 25% of the readers of DE always or nearly always read the advertising, while 20% of MD and ME readers and 16% of PE readers read the advertising that often. 52% of PE readers, 50% of MD readers, 48% of ME readers, and 46% of DE readers frequently read advertising when reading trade publications. 30% of all the readers seldom or never read the advertising. The homogeneity test shows that chi square equals 19.90 * with 12 degrees of freedom.

Figure 26 (Question 72) presents data on the question of whether or not there is sufficient information for the design of gears; and if not, how would they like to see additional information presented. 81%

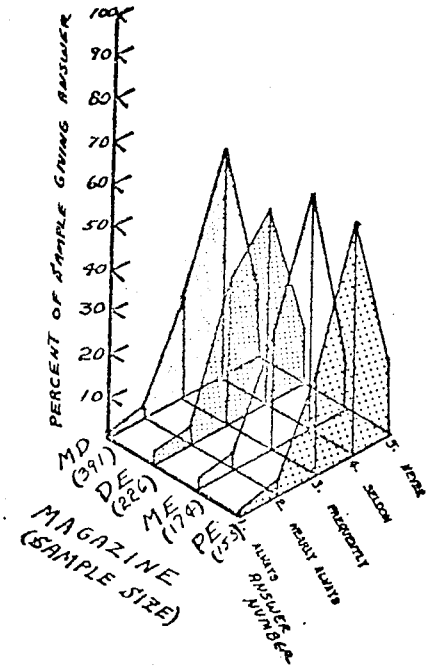


Figure 22. When reading trade publications, how often do you read technical papers in all fields:

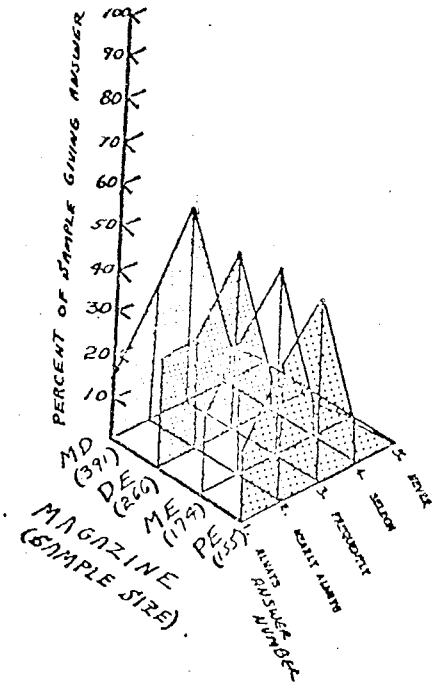


Figure 23. When reading trade publications, how often do you read technical papers you are interested in:

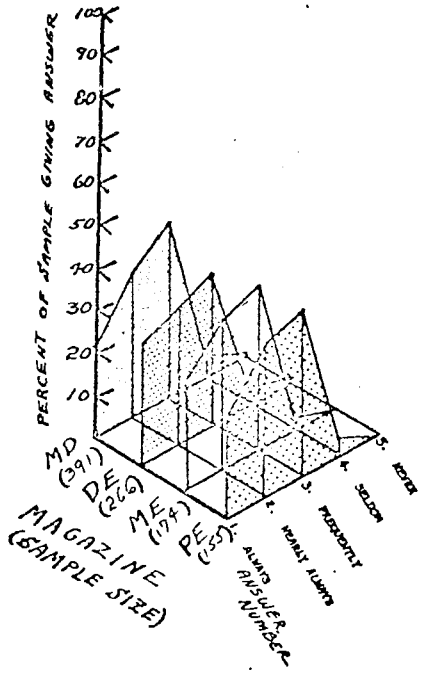


Figure 24. When reading trade publications, how often do you read technical papers related to your work:

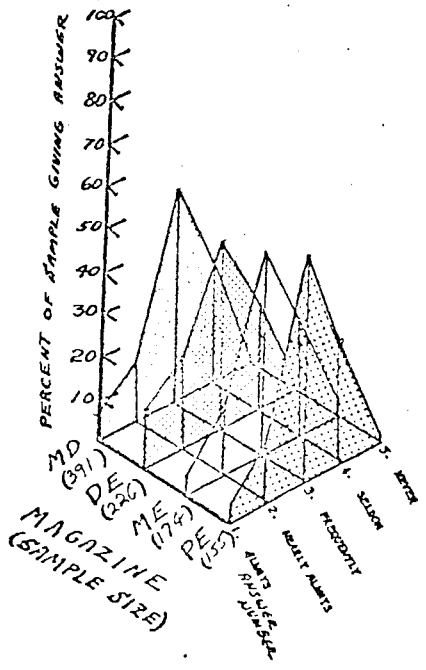


Figure 25. When reading trade publications, how often do you read advertising:

of the readers of MD, 78% of the readers of DE, 73% of the readers of ME, and 71% of the readers of PE feel that their information is sufficient for the design of gears. 9% of the readers of PE would like to see the method of solution and another 9% would like to see the equations to do calculations listed. 5% of the readers of ME would like to see solved problems, compared to about 3% of the MD readers, while only 1% of DE and PE readers would like to see solved problems. The other methods of presentation did not appear popular to the designers as an additional source of information. The homogeneity test shows that chi square equals 27.58 with 24 degrees of freedom.

Figure 27 (Question 73) presents data on the question of whether or not there is sufficient information for the design of linkages; and if not, how would they like to see it presented. 61% of the MD readers, 60% of the DE readers, and 59% of ME readers feel that there is sufficient information, while only 51% of the readers of PE feel that the existing information is sufficient. 19% of the PE readers, 17% of the MD readers, 15% of DE readers, and 11% of PE readers would like to see listed equations to do calculations, while 7% of the other readers would like to see such equations. Over 15% of the readers of ME would like to see method of solution, while only 8% of MD and DE readers, and 7% of PE readers favor this type of presentation. The homogeneity test shows that chi square equals 18.93 with 24 degrees of freedom.

Figure 28 (Question 74) presents data on the question of whether or not there is sufficient information for the design of cams; and if not, how would they like to see the additional information. 65% of MD readers feel that there is sufficient information in this area, while only 60% of the other readers feel this way about cam design information.

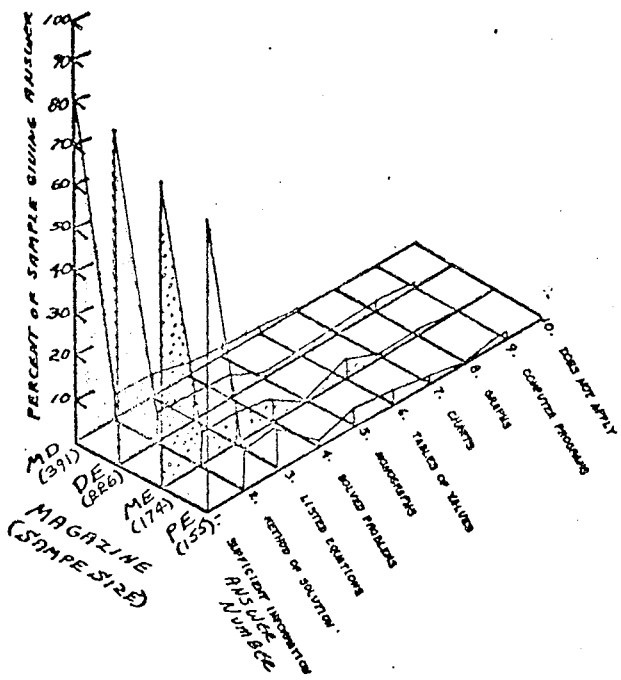


Figure 26. Do you find inadequate information in the design of Gears and how would you like to see it:

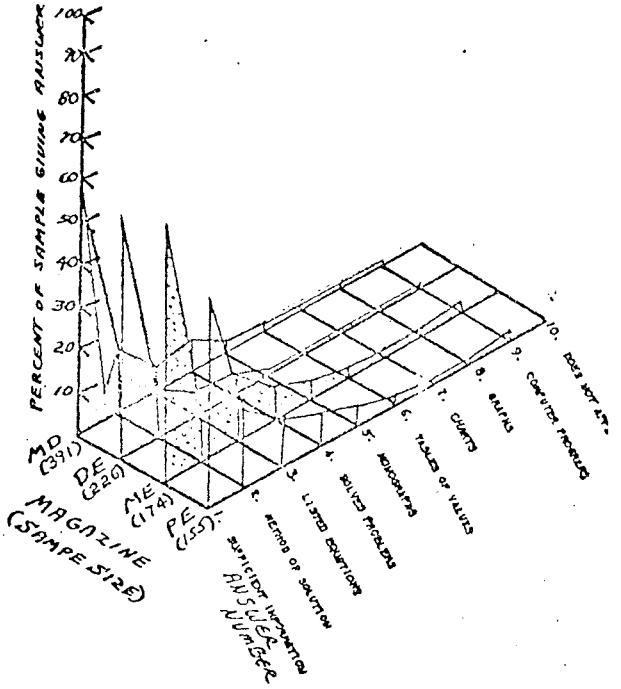


Figure 27. Do you find inadequate information in the design of Linkages and how would you like to see it:

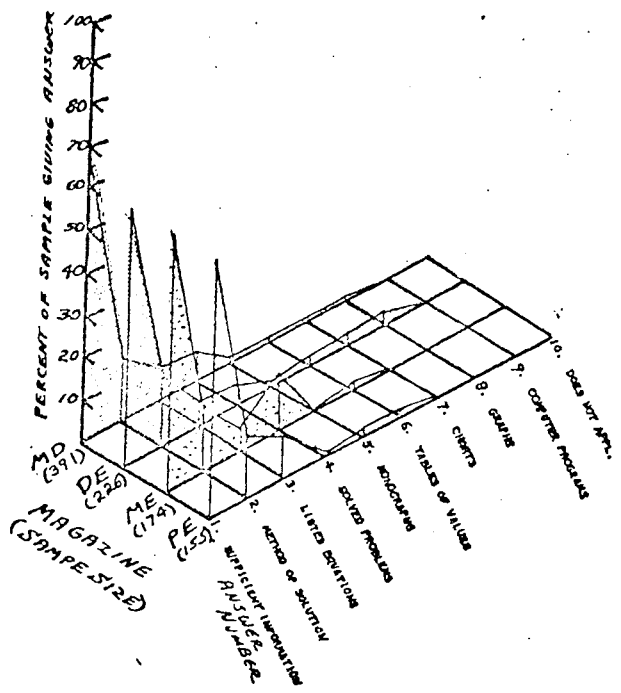


Figure 28. Do you find inadequate information in the design of Cams and how would you like to see it:

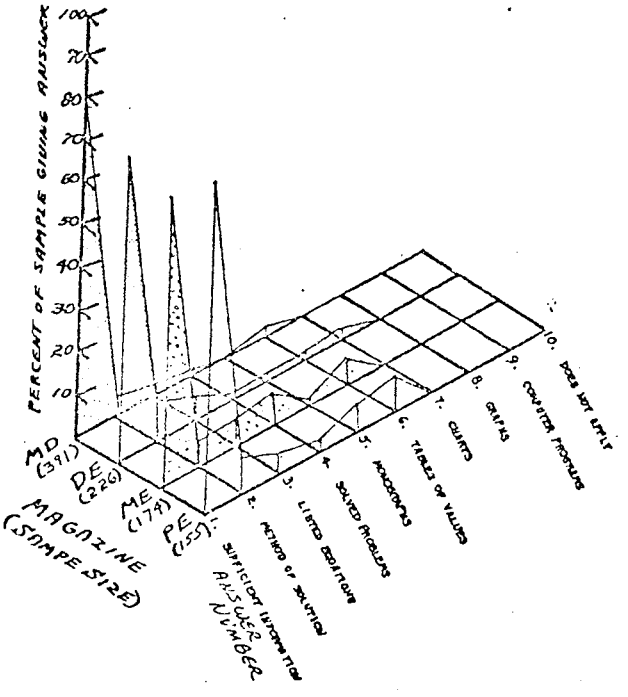


Figure 29. Do you find inadequate information in the design of Fasteners and how would you like to see it:

15% of all of the readers would like to see method of solution. 10% of the readers of PE, 7% of MD readers, 6% of DE readers, and 4% of ME readers prefer listed equations to do calculations. 12% of ME readers would like to see solved problems, while only 6% of MD readers, 4% of DE readers, and 1% of PE readers would like to see this method. The other forms of presentation were not popular among the readers, with the exception of 5% of DE readers preferring graphs and 4% of DE readers preferring the use of charts to present additional information for the design of cams. The homogeneity test shows that chi square equals 31.50 with 24 degrees of freedom.

Figure 29 (Question 75) presents data on the question of whether or not there is sufficient information for the design of fasteners; and if not, how would they like to see it presented. 79% of MD and PE readers, 77% of DE readers, and 73% of ME readers feel that there is sufficient information for the design of fasteners. 5% of MD readers and 4% of DE readers would like to see methods of solution while none of the readers of ME and PE would like to see this method. About 4% of the readers of all of the magazines would like to see listed equations to do calculations. 7% of the readers of ME would like to see solved problems, while only 2% of the other readers prefer this method of presentation. 6% of PE readers would like to see monographs, but monographs are not popular with the other readers. Tables of values for any problem are popular among the readers, 8% of PE readers, 7% of ME readers, 5% of MD readers, and 4% of DE readers. 7% of the readers of DE and 6% of the readers of MD and ME were interested in the use of charts, while none of the readers of PE were. The homogeneity test shows that chi square equals 38.50*** with 18 degrees of freedom.

Figure 30 (Question 76) presents data on the question of whether or not there is sufficient information for the design of power drive; and if not, how would the designers like to see the additional information presented. 69% of the readers of DE, 67% of the readers of MD, and 67% of the readers of PE feel there is sufficient information for the design of power drive, while only 57% of the readers of ME share this feeling. 16% of PE readers, 13% of ME readers, 12% of DE readers, and 10% of MD readers would like to see method of solution. Slightly over 10% of all the readers would like to see listed equations to do calculations. 13% of ME readers would like to see solved problems, while only 6% of MD readers, 4% of DE readers, and 2% of PE readers prefer this method. The other methods of presentation were not popular with the readers of the magazines. The homogeneity test shows that chi square equals 26.68 with 18 degrees of freedom.

Figure 31 (Question 77) presents data on the question of whether or not there is sufficient information for the design of seals; and if not, how would they like to see more information presented. 74% of the readers of MD, 71% of the readers of DE, and 69% of the readers of PE feel that there is sufficient information in this area, while only 60% of the readers of ME feel this way. 11% of the readers of ME and PE would like to see method of solutions, while 8% of DE readers and 6% of MD readers feel this way. The use of solved problems is moderately popular as a source of additional information for the design of seals, with 8% of ME readers, 5% of MD and DE readers, and 4% of PE readers preferring this method. The use of charts is preferred by 7% of PE readers, 6% of MD and ME readers, and 4% of DE readers. 8% of the ME readers, 4% of the DE readers, 3% of the MD readers, and less than 1%

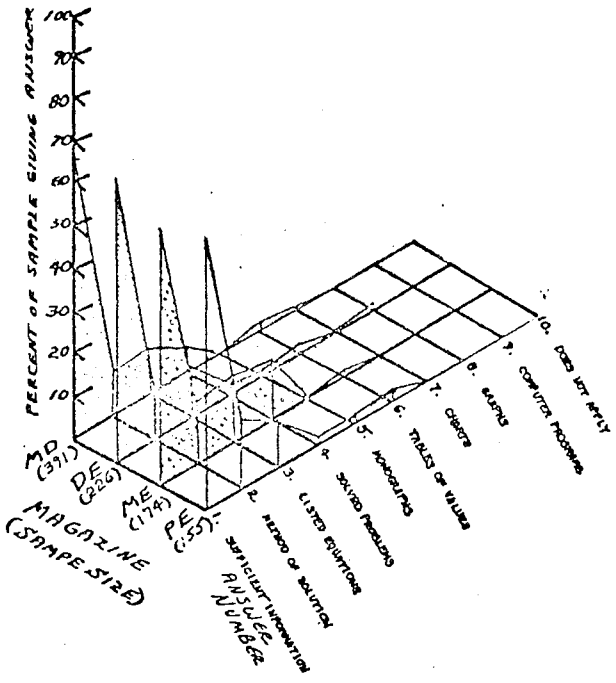


Figure 30. Do you find inadequate information in the design of Power Drive and how would you like to see it:

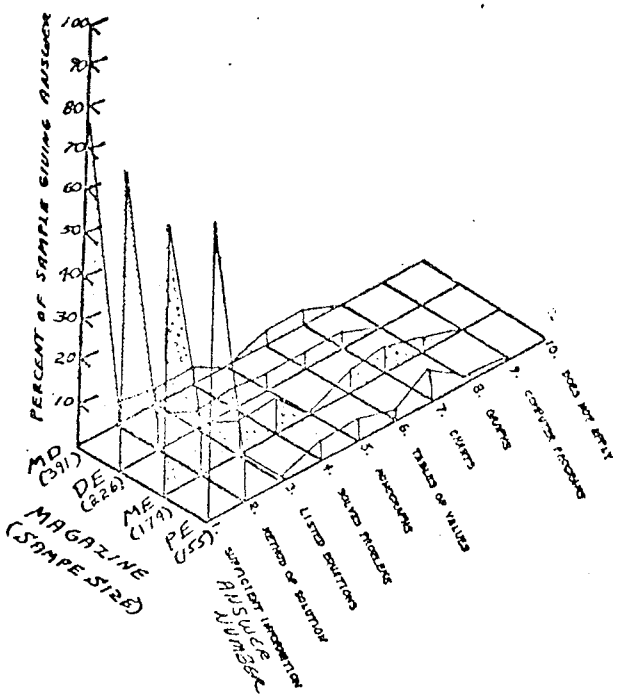


Figure 31. Do you find inadequate information in the design of Seals and how would you like to see it:

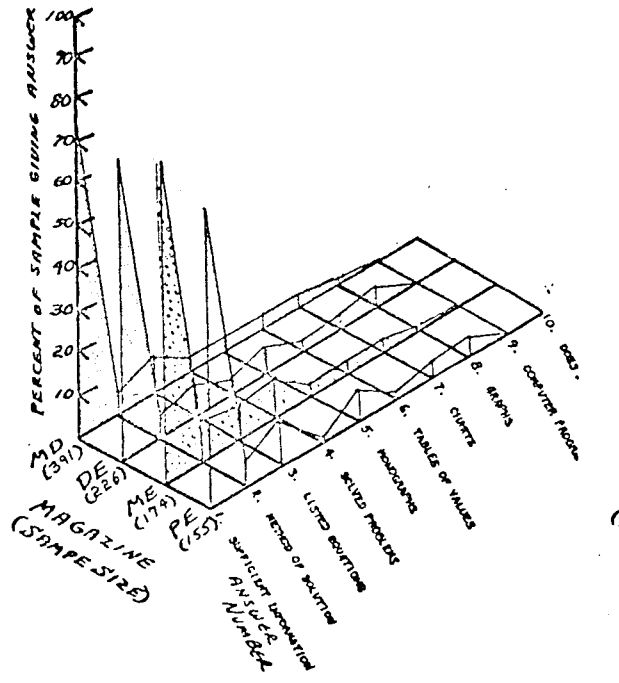


Figure 32. Do you find inadequate information in the design of Springs and how would you like to see it:

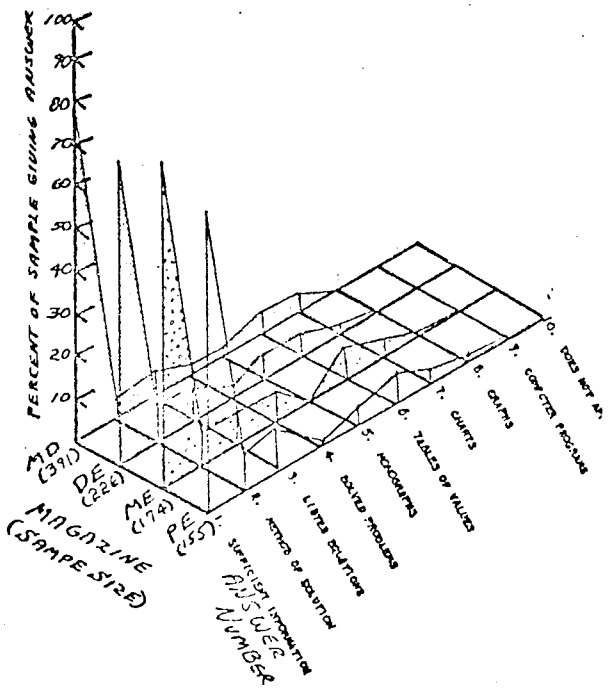


Figure 33. Do you find inadequate information in the design of Bearings and how would you like to see it:

of PE readers are looking for listed equations. The homogeneity test shows that chi square equals 31.83 with 21 degrees of freedom.

Figure 32 (Question 78) presents data on the question of whether or not there is sufficient information for the design of springs; and if not, how would the designers like to see the information presented. 9% of PE readers, 8% of MD readers, and 7% of DE and ME readers would like to see listed equations to do calculations, while 8% of ME readers, 6% of DE readers, and 5% of MD and PE readers prefer to see method of solution. Solved problems are popular with 7% of MD readers, but less than 3% of all the other readers are in favor of this method. 6% of DE readers and 3% of MD and ME readers are looking for monographs to add information in the area of spring design. The homogeneity test shows that chi square equals 24.05 with 21 degrees of freedom.

Figure 33 (Question 79) presents data on the question of whether or not there is sufficient information for the design of bearings; and if not, how would the designer like to see the additional information presented. 79% of MD readers, 72% of DE readers, and 68% of ME and PE readers feel that there is sufficient information in this area. Method of solution and listed equations to do calculations are fairly popular among the readers of all of the magazines. Method of solution is favored by 8% of PE readers, 7% of DE and ME readers, and 5% of MD readers, while 8% of PE readers, and 6% of the other readers favor the listed equations. 8% of ME readers, 7% of DE and ME readers, and 4% of MD readers favor tables of values for any problems. Once again the other methods of presentation were not popular. The homogeneity test shows that chi square equals 17.16 with 21 degrees of freedom.

Figure 34 (Question 80) presents data on the question of whether or

not there is sufficient information for the design of electro-mechanical components; and if not, how would the designers like to see the additional information presented. Method of solution is very popular with 21% of the readers of DE, and moderately popular with the other readers, 17% of ME readers, 12% of PE readers, and 11% of MD readers. 10% of DE and ME readers favor listed equations to do calculations, as do 7% of MD and PE readers. 10% of ME readers favor solved problems, while only 6% of MD readers, 4% of DE readers, and 2% of PE readers suggest this method of implementing additional information. The homogeneity test shows that chi square equals 25.59 with 21 degrees of freedom.

Figure 35 (Question 81) presents data on the question of whether or not there is sufficient information for the design of fluid power and pneumatics; and if not, how would the designer like to see the additional information presented. Over 70% of the readers of MD, DE, and PE feel that the information is sufficient in this area, while only 60% of the readers of ME feel this way. 13% of DE, ME, and PE readers favor this method of solution, as do 10% of the MD readers. 11% of ME readers, 9% of MD and PE readers, and 6% of DE readers favor listed equations. It is interesting to note that 16% of ME readers favor solved problems, while only 7% of MD readers, 5% of DE readers, and 2% of PE readers favor this method. The homogeneity test shows that chi square equals 22.29** with 12 degrees of freedom.

Figure 36 (Question 83) presents data on the question of how much time the designer spends reading trade magazines. 21% of the readers of DE read trade magazines less than 1 hour/month, while 12% of ME readers, 11% of MD readers, and only 9% of PE readers read these trade magazines less than 1 hour/month. Nearly 50% of all the readers spend

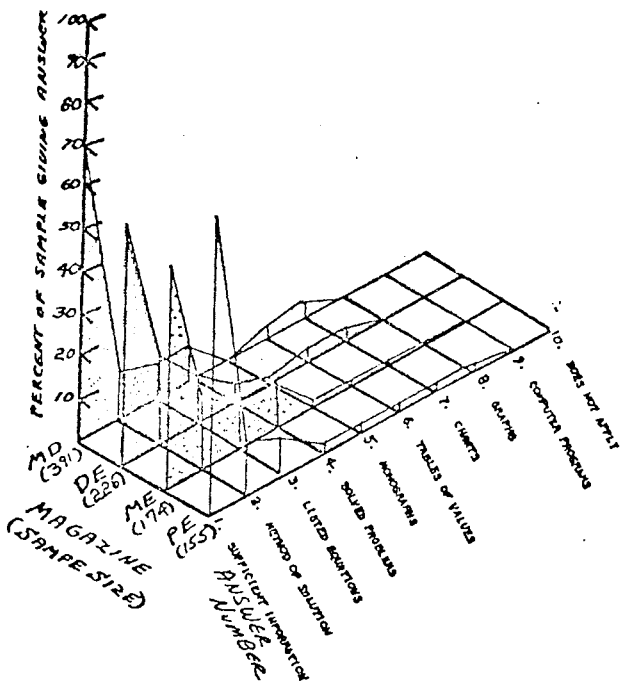


Figure 34. Do you find inadequate information in the design of Electromechanical Components and how would you like to see it:

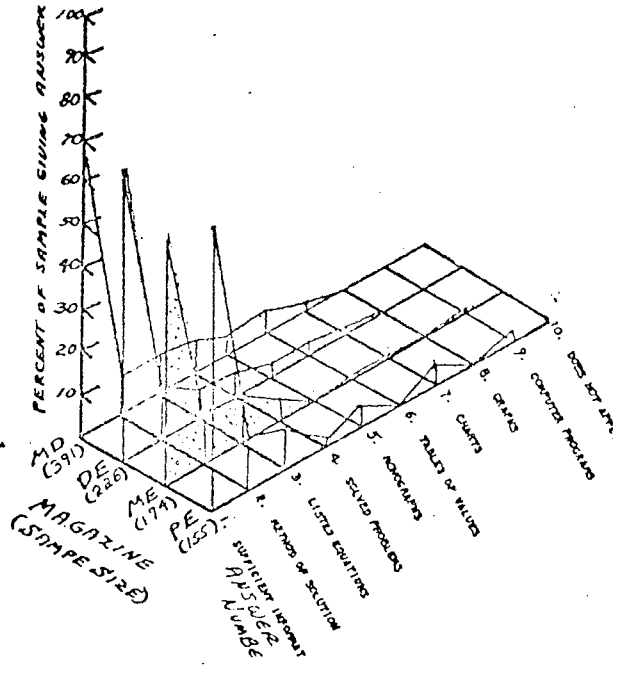


Figure 35. Do you find inadequate information in the design of Fluid Power and Pneumatics and how would you like to see it:

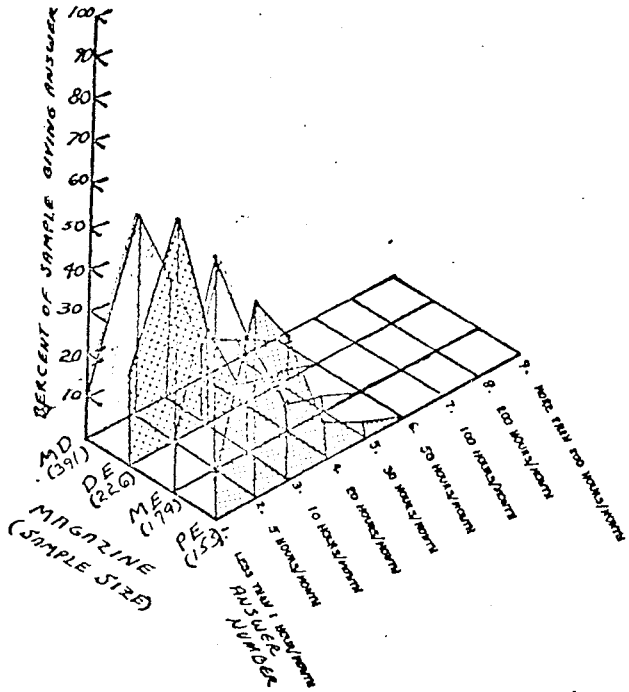


Figure 36. To keep up to date in design, what is the typical time you spend reading trade magazines:

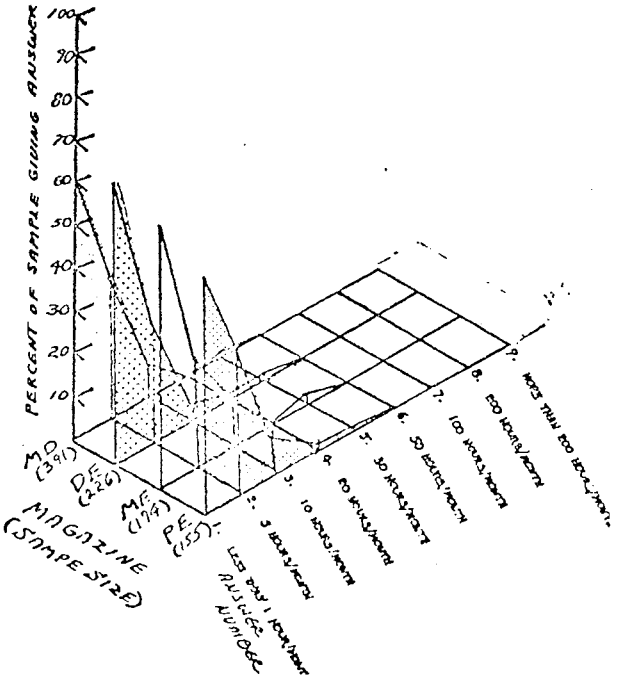


Figure 37. To keep up to date in design, what is the typical time you spend in reading research reports:

less than 5 hours/month reading trade publications. 14% of MD readers and 13% of PE readers spend at least 20 hours/month reading trade magazines, while 10% of ME readers and 6% of DE readers spend that much time. The homogeneity test shows that chi square equals 11.46 with 12 degrees of freedom.

Figure 37 (Question 84) presents data on the question of how often the designer reads research reports. 67% of the readers of DE spend less than 1 hour/month reading research reports, while 62% of ME readers, 60% of MD readers, and 56% PE readers spend that amount of time on research reports. 90% of the readers of the magazines read these reports less than 5 hours/month. 10% of ME readers, 8% of PE readers, 7% of MD readers, and 3% of DE readers read research reports 10 hours/month. The homogeneity test shows that chi square equals 12.16 with 12 degrees of freedom.

Figure 38 (Question 85) presents data on the question of how often the designer reads company catalogs. 51% of DE readers, 49% of MD readers, 45% of PE readers, and 43% of ME readers spend less than 1 hour/month, while 89% of DE readers, 85% of MD readers, 82% of PE readers, and 80% of ME readers spent 5 hours/month or less reading these catalogs. The homogeneity test shows that chi square equals 6.88 with 9 degrees of freedom.

Figure 39 (Question 86) presents data on the question of how much time the designer spends going to workshops at universities. 97% of the readers of DE, 92% of MD readers, 83% of PE readers, and 79% of ME readers go to workshops less than 1 hour/month. 21% of the readers of ME go to these workshops either 5 or 10 hours/month, while 17% of PE readers, 9% of MD readers, and only 3% of DE readers go that often. The

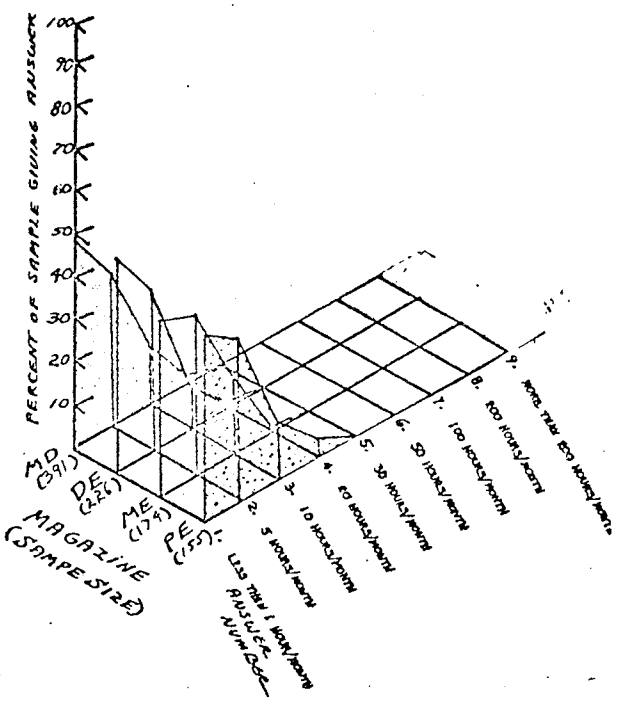


Figure 38. To keep up to date in design, what is the typical time you spend in reading company catalogs:

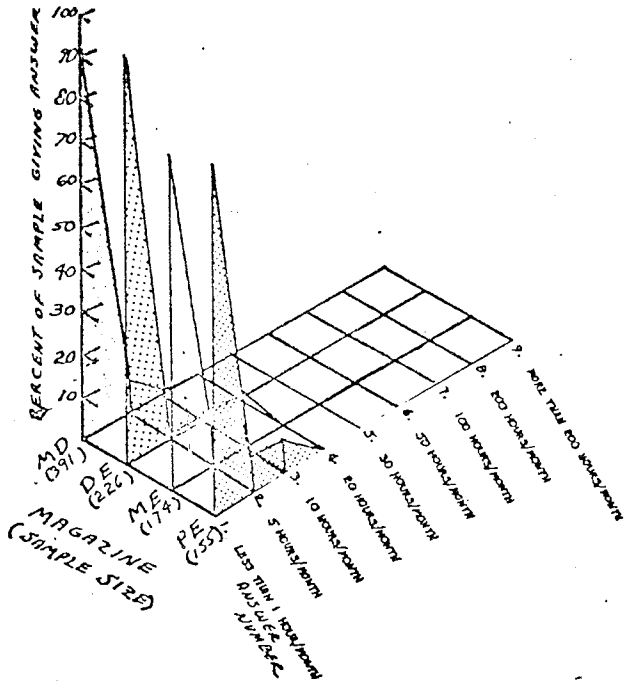


Figure 39. To keep up to date in design, what is the typical time you spend attending workshops at universities:

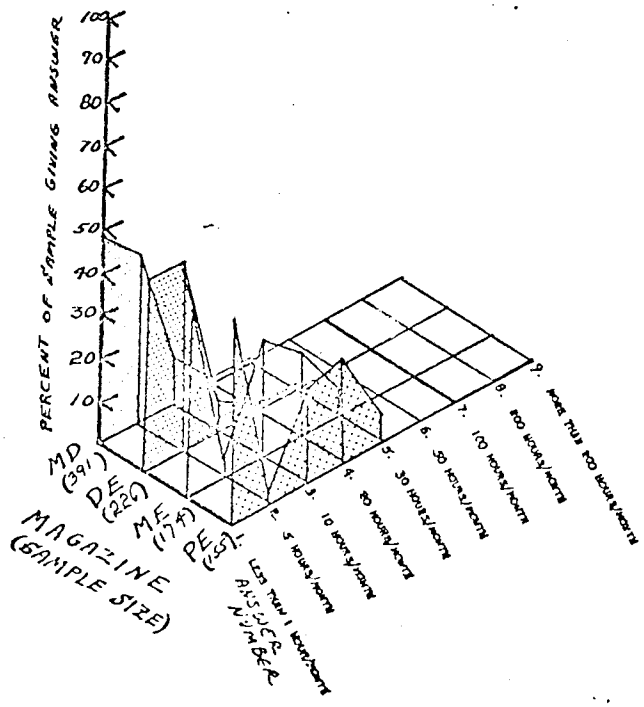


Figure 40. To keep up to date in design, what is the typical time you spend in reading technical papers:

homogeneity test shows that chi square equals 27.32**** with 6 degrees of freedom.

Figure 40 (Question 90) presents data on the question of how much time the designer spends reading technical papers. 48% of MD and PE readers spend less than 1 hour/month reading technical papers, as do 44% of DE and ME readers. It is interesting to note that 45% of DE readers and 40% of MD readers spend 5 hours/month and only 3% of ME readers and 2% of PE readers spend that amount of time on reading technical papers. 6% of the readers of ME and PE read papers of a technical nature 30 hours/month, while only 1% of MD and DE readers spend that much time. The homogeneity test shows that chi square equals 252.02**** with 12 degrees of freedom.

This section analyzed the responses of designers that read the magazines. The responses indicate "working" conditions of the designers. Several of the "working" conditions were shown to affect which magazine the designer reads.

The design responsibility of the designer, the formal education of the designer, and the length of time that the designer has been designing all affect which magazine the designer reads. Using commercially available components, having other companies manufacture special components, and reading advertisements (all measures of the use of advertising) effect which magazine the designer reads. Other "working" conditions that affect which magazine the designer reads are the use of textbooks, reading technical reports, attending workshops at universities, the frequency of designing cams, and the sufficiency of design information on fasteners and fluid power equipment.

The importance of these findings will be discussed in the final

chapter, Discussion and Conclusions.

Section III will analyze several "working" conditions of the designers that have access to the magazine. In the section, as previously mentioned, access will mean having the magazine available to them but not reading it.

Section III

Results

Figure 41 (Question 2) presents data on the question of the design responsibility of the designer that has access to the magazines. Over 56% of the designers that have access to DE have mechanism responsibility, as do 53% of those with access to MD and PE, while only 35% of those with access to ME have such responsibility. 18% of the designers that have access to ME are responsible for stress design, while 12% of those with access to MD and PE have that responsibility and 9% of those with access to DE are responsible for design in this area. 30% of those with access to ME have "other" design responsibility, while 24% of the designers that have access to the other magazines have "other" design responsibility. Very few designers that have access to these magazines have design responsibility in the area of control, fluid mechanics, aerodynamics, dynamics & vibrations, thermodynamics, or bearings & lubrication. The homogeneity test shows that chi square equals 24.71 with 24 degrees of freedom.

Figure 42 (Question 3) presents data on the question of the formal education level of the designer that has access to the magazines. 55% of the designers that have access to ME have a BS, while 19% have a MS, 16% have a HS, and 10% have an AS. 50% of those that have access to PE have

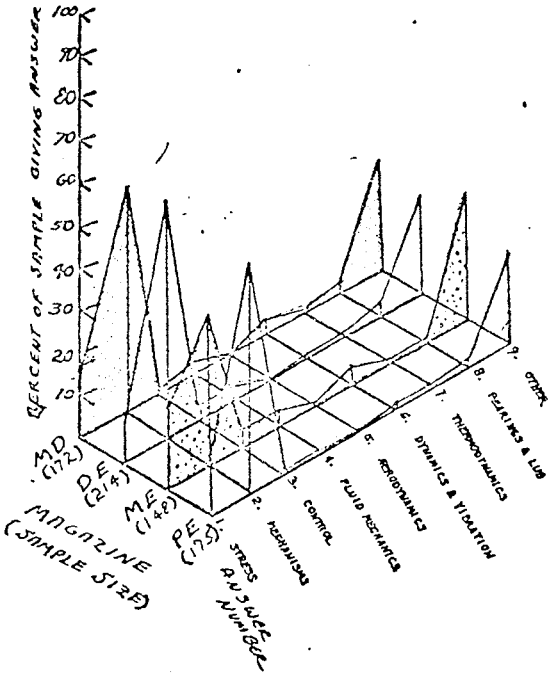


Figure 41. Design responsibility where most of designer's time is spent:

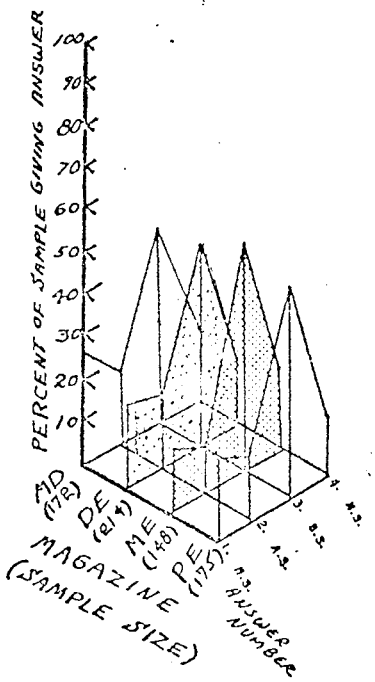


Figure 42. Formal Education:

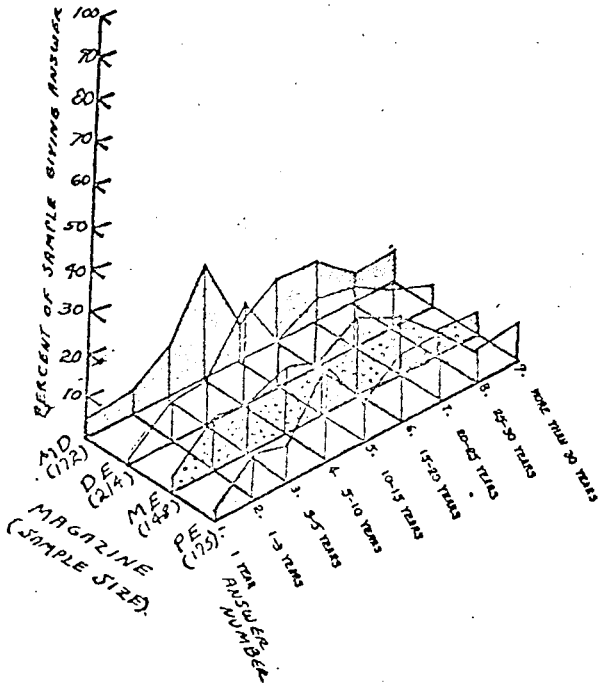


Figure 43. Total time you have worked in design:

a BS, while 20% have a HS, 15% have an AS, and 14% have a MS. 48% of those with access to DE have a BS, while 20% have a HS, 18% have an AS, and 15% have a MS. 45% of the designers that have access to MD have a BS, while 23% have a HS, 18% have an AS, and 15% have a MS. The homogeneity test shows that chi square equals 22.08** with 9 degrees of freedom.

Figure 43 (Question 5) presents data on the response to the question of how long the designer has worked in the design field. 17% of the designers that have access to ME have been in design for 3 years or less, while 13% of those with access to PE, 10% of those with access to DE, and 9% of those with access to MD have been in design for 3 years or less. 10% of the designers with access to the magazines have been in design for a period of 3-5 years, while 25% of those with access to MD, DE, and PE have been in design for a period of 5-10 years, while only 16% of those with access to ME have been in design that long. 32%, 30%, 25%, and 25% of the designers with access to ME, DE, MD, and PE, respectively, have been in design for a period of 10-20 years, while over 25% of the designers with access to the magazines have been in design for more than 20 years. The homogeneity test shows that chi square equals 15.02 with 24 degrees of freedom.

Figure 44 (Question 22) presents data on the question of how often the designer that has access to the magazines designs gears. 45% of the designers with access to MD, DE, and PE seldom or never design gears, while 55% of those with access to ME seldom or never design these components. 10% of the designers with access to MD, DE, and PE design gears at least once a week, while only 2% of those with access to ME design gears that often. Over 25% of those with access to MD, DE, and

PE design gears at least once every three months, while 19% of those with access to ME design gears with that frequency. The homogeneity test shows that chi square equals 16.44 with 21 degrees of freedom.

Figure 45 (Question 23) presents data on the question of the frequency with which the designers that have access to the magazines design cams. 10% of the designers that have access to MD, DE, and PE design cams every week, while only 3% of those with access to ME design cams with that frequency. 25% of those with access to MD, DE and PE design cams at least once every three months, while only about 19% of those with access to ME design this component that often. Over 40% of the designers that have access to the magazines seldom or never design cams. The homogeneity test shows that chi square equals 14.26 with 21 degrees of freedom.

Figure 46 (Question 24) presents data on the frequency that linkages are designed by designers that have access to the magazines. Over 11% of those with access to MD, DE, and PE design linkages every week, while only 6% of those with access to ME design linkages that often. Over 42% of the designers that have access to the magazines design linkages at least once every three months, while only 20% of the designers with access seldom or never design this component. The homogeneity test shows that chi square equals 12.13 with 21 degrees of freedom.

Figure 47 (Question 25) presents data on the frequency of how often the designer that has access to the magazines designs fasteners. Over 21% of the designers with access to the magazines design fasteners at least once every week, and nearly 50% of the designers design them at least once every three months. Around 30% of those designers seldom or never design fasteners. The homogeneity test shows that chi square equals 4.87 with 21 degrees of freedom.

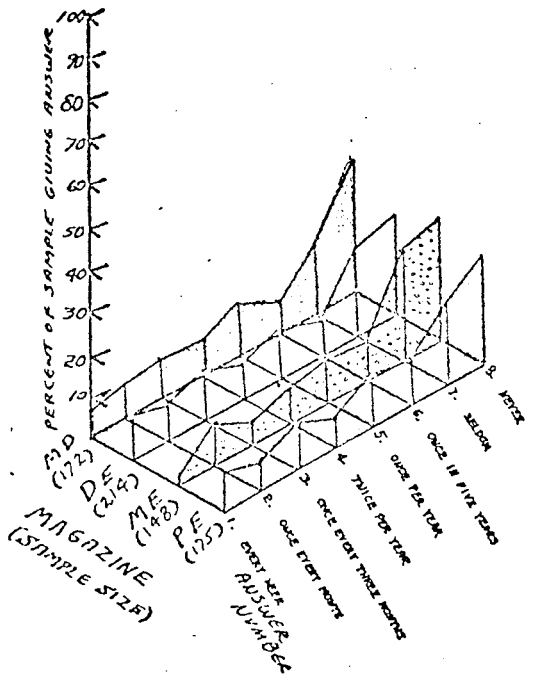


Figure 44. How frequently do you design Gears:

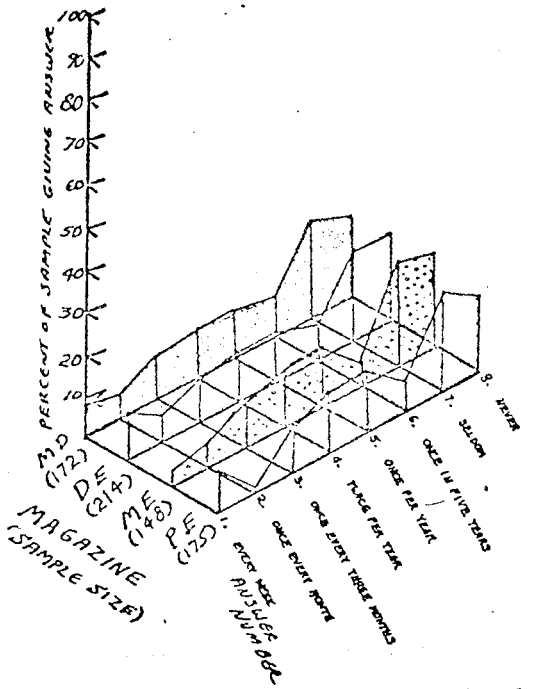


Figure 45. How frequently do you design Cams:

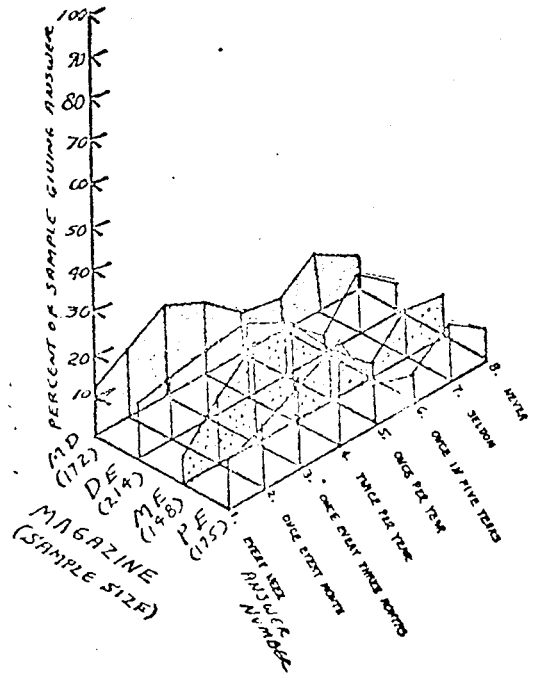


Figure 46. How frequently do you design Linkages:

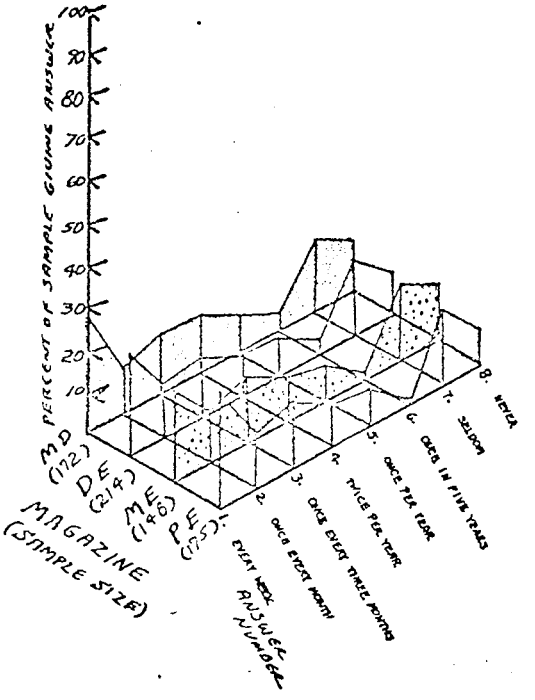


Figure 47. How frequently do you design Fasteners:

Figure 48 (Question 26) presents data on the frequency that designers that have access to the magazines design power drive. 13% of the designers that have access to MD, DE, and PE design power drive at least once a week, as do 5% of the designers with access to ME, while nearly 40% of all the designers that have access to the magazines design power drive at least once every three months. About 30% of those with access seldom or never design power drive. The homogeneity test shows that chi square equals 10.62 with 21 degrees of freedom.

Figure 49 (Question 27) presents data on the frequency that designers that have access to the magazines design seals. Over 12% of those with access to MD and DE and 5% of those with access to ME and PE design seals weekly. 30% of the designers with access to MD, ME, and PE design seals at least once every three months, while 42% of the designers that have access to DE design seals that often. 40% of those that have access to the magazines seldom or never design seals. The homogeneity test shows that chi square equals 29.53 with 21 degrees of freedom.

Figure 50 (Question 28) presents data on the frequency that designers with access to the magazines design springs. 10% of those with access to the magazines design springs at least once a week, while 40% of those with access design springs at least once every three months. 30% of those with access seldom or never design springs. The homogeneity test shows that chi square equals 12.47 with 21 degrees of freedom.

Figure 51 (Question 29) presents data on the frequency that the designers with access to the magazines design bearings. 13% of those with access to the magazines design bearings once a week, while over

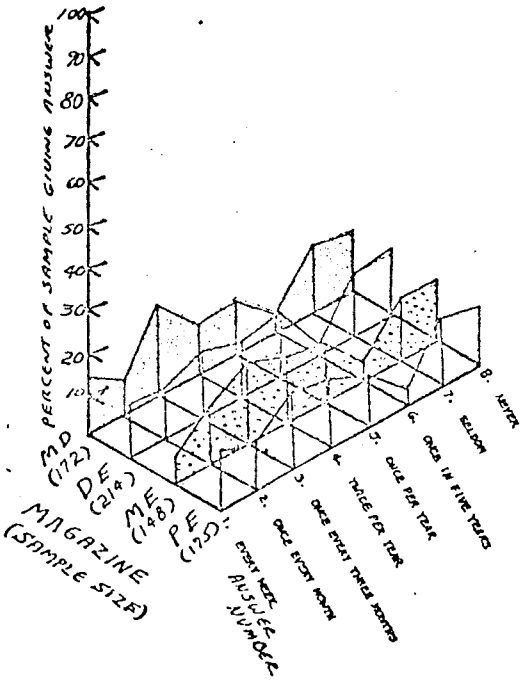


Figure 48. How frequently do you design Power Drive:

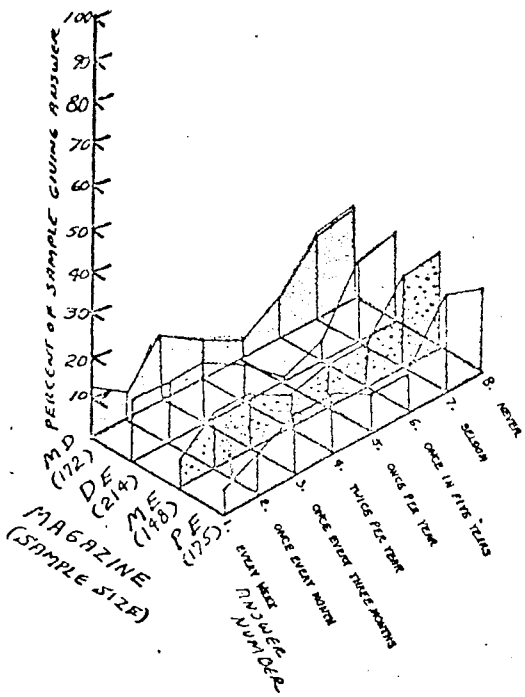


Figure 49. How frequently do you design Seals:

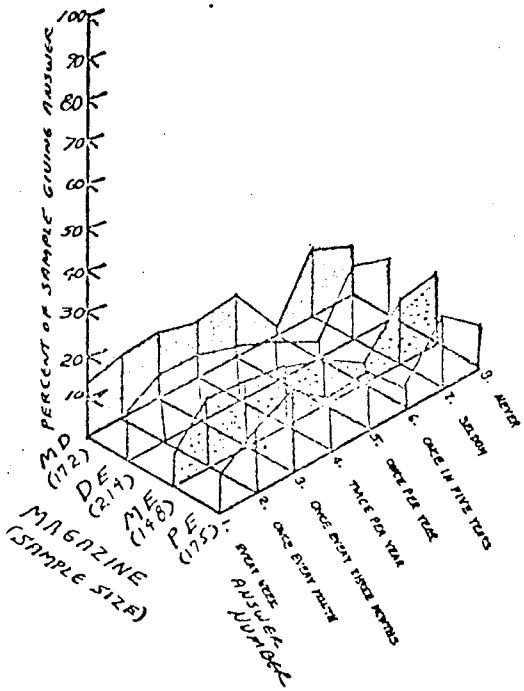


Figure 50. How frequently do you design Springs:

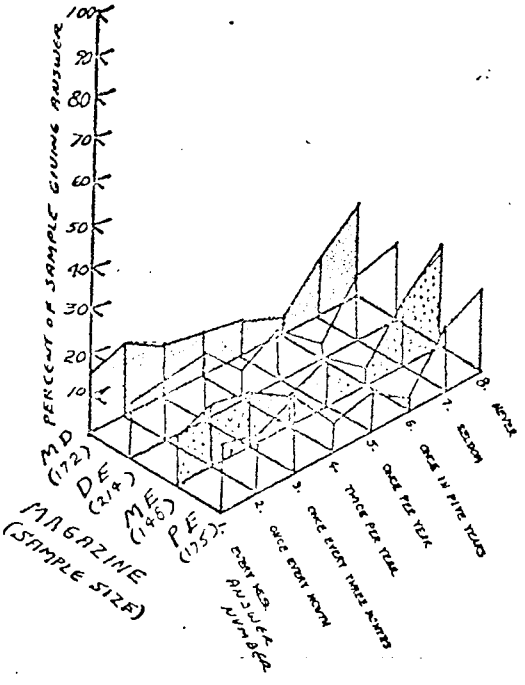


Figure 51. How frequently do you design Bearings:

40% of those with access design this component at least once every three months. 34% of those with access to MD, DE, and PE seldom or never design bearings, while 40% of those with access to ME seldom or never design bearings. The homogeneity test shows that chi square equals 7.79 with 21 degrees of freedom.

Figure 52 (Question 30) presents data on the frequency that designers that have access to the magazines design electromechanical components. About 10% of the designers with access to the magazines design E-M components every week, while 31% design this component at least once every three months. 45% of the designers with access to the magazines seldom or never design electromechanical components. The homogeneity test shows that chi square equals 7.80 with 21 degrees of freedom.

Figure 53 (Question 31) presents data on the frequency that designers that have access to the magazines design fluid power equipment. 12% of those that have access to DE design fluid power equipment every week, while only 4% of those with access to ME, MD, and PE design this equipment this often. 36% of the designers that have access to DE design fluid power equipment at least once every three months, while 20% of those with access to the other magazines design the equipment that often. Nearly 50% of the designers with access to MD, ME, and PE seldom or never design fluid power equipment, while only 40% of those with access to DE seldom or never design fluid power equipment. The homogeneity test shows that chi square equals 33.02** with 21 degrees of freedom.

Figure 54 (Question 36) presents data on how often the designer that has access to the magazines uses commercially available components. About 25% of the designers that have access to the magazines always use commercially available components. Over 41% of those with access to ME

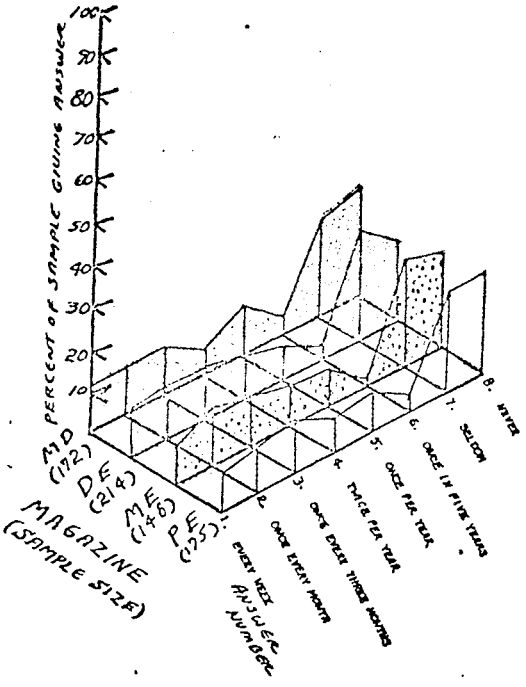


Figure 52. How frequently do you design Electromechanical Components:

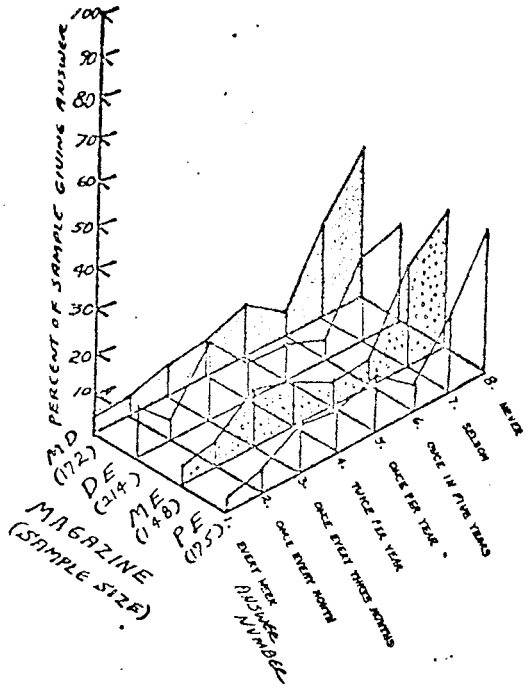


Figure 53. How frequently do you design Fluid Power Equipment:

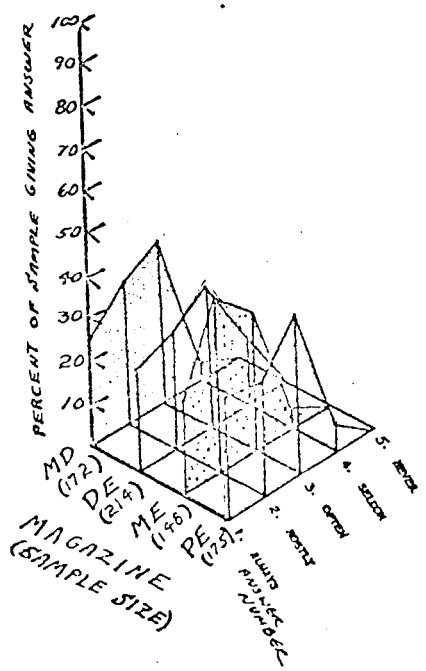


Figure 54. How do you use commercially available components:

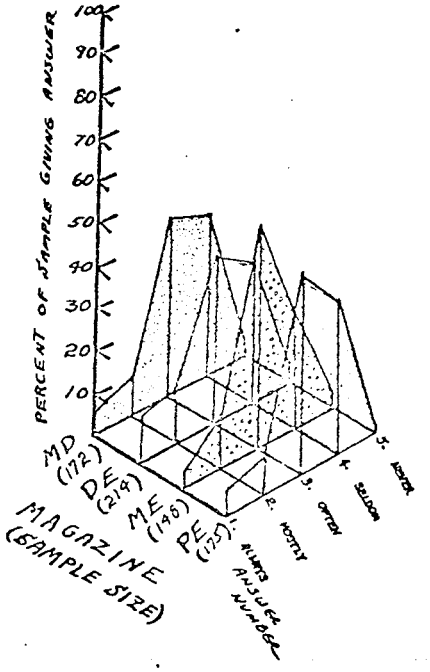


Figure 55. Do you have other companies manufacture special components:

mostly use these available components, as do 33% of those with access to MD, while only 27% of those with access to DE and PE mostly use commercially available components. 16% of those with access to DE seldom or never use commercially available components, while only about 5% of those with access to the other magazines are in a similar situation. The homogeneity test shows that chi square equals 24.17** with 12 degrees of freedom.

Figure 55 (Question 37) presents data on the frequency that designers that have access to the magazines have other companies manufacture special components. About 20% of those with access to the magazines always or mostly have other companies manufacture special components. 42% of those with access to MD, 38% of those with access to DE and PE, and 32% of those with access to ME seldom or never have other companies manufacture special components. The homogeneity test shows that chi square equals 12.22 with 12 degrees of freedom.

Figure 56 (Question 56) presents data on how many handbooks the designers that have access to the magazines use. 38% of the designers that have access to ME use less than 4 handbooks, as do 34% of those with access to the other magazines. 17% of the designers that have access to DE use more than 20 handbooks, as do 12% of those with access to MD and PE, and 8% of those with access to ME. The homogeneity test shows that chi square equals 24.60 with 24 degrees of freedom.

Figure 57 (Question 61) presents data on the use of textbooks by designers that have access to the magazines. About 28% of the designers that have access to the magazines use less than 4 textbooks, while 55% of them use more than 6 textbooks. Nearly 1/5 of the designers use more than 20 textbooks. The homogeneity test shows that chi square

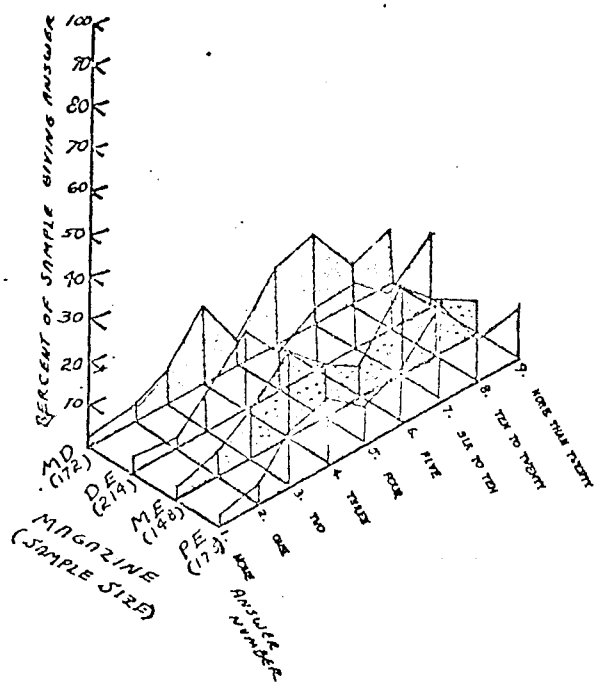


Figure 56. How many handbooks do you use:

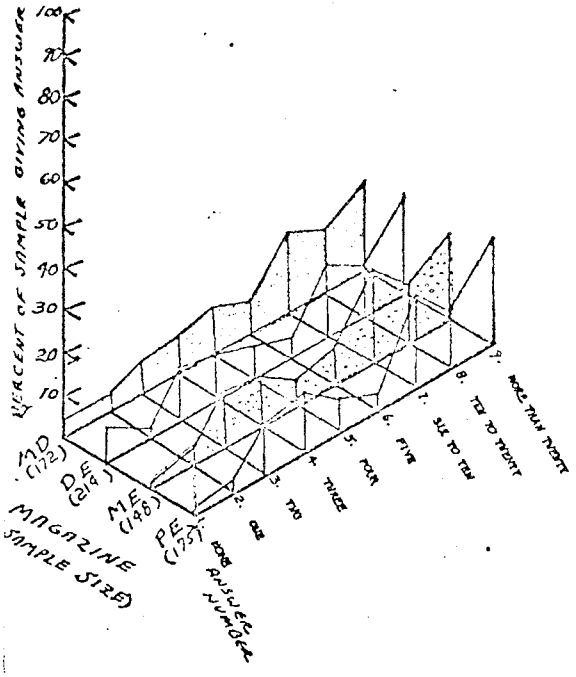


Figure 57. How many textbooks do you use:

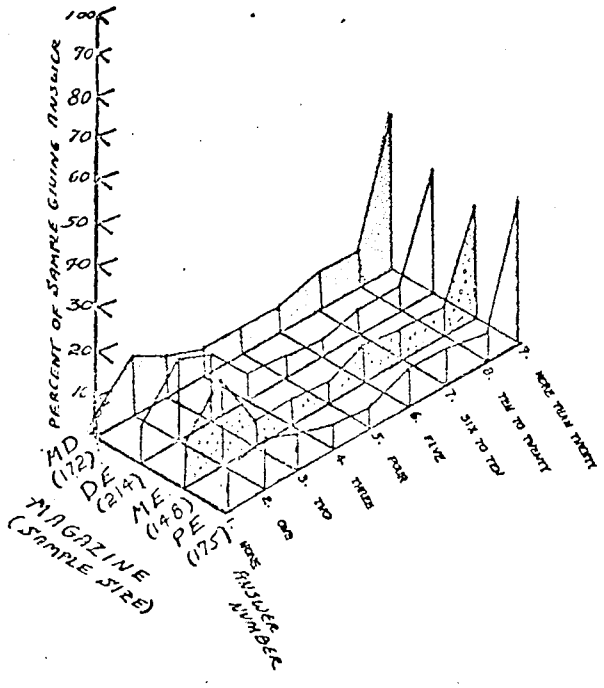


Figure 58. How many company standards do you use:

equals 26.69 with 24 degrees of freedom.

Figure 58 (Question 66) presents data on the use of company standards by the designers that have access to the magazines. Nearly 50% of the designers with access to DE use less than 4 company standards, while 42% with access to ME, and 35% with access to MD and PE use that many. 50% of the designers that have access to MD and PE and 40% of those with access to DE and ME use more than 6 company standards. Nearly 1/3 of the designers that have access to MD and PE use more than 20 company standards. The homogeneity test shows that chi square equals 20.93 with 24 degrees of freedom.

Figure 59 (Question 68) presents data on the frequency that designers that have access to the magazines read technical papers in all fields, when reading trade publications. Nearly 75% of the designers with access to the magazines seldom or never read technical papers in all fields, while only 5% of the designers always or nearly always read the technical papers in all fields. The homogeneity test shows that chi square equals 10.92 with 12 degrees of freedom.

Figure 60 (Question 69) presents data on the frequency that designers that have access to the magazines read technical papers that they are interested in. Nearly 40% of the designers that have access to the magazines always or nearly always read technical papers in which they are interested, while only 10% of those with access seldom or never read those papers. About 50% of all the designers that have access to the magazines frequently read technical papers in which they are interested. The homogeneity test shows that chi square equals 16.41 with 12 degrees of freedom.

Figure 61 (Question 70) presents data on the frequency that designers that have access to the magazines read technical papers related

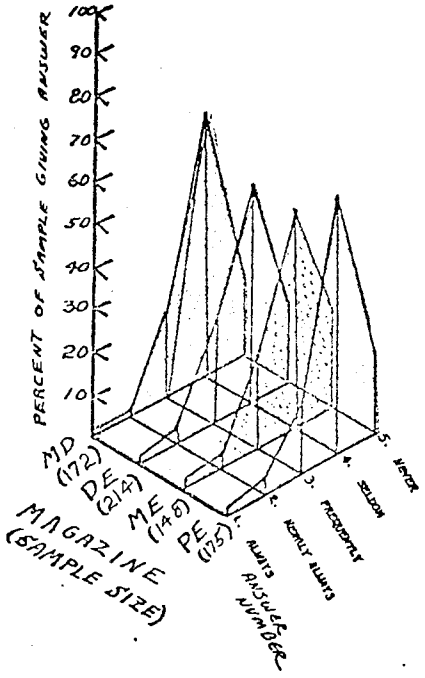


Figure 59. When reading trade publications, how often do you read technical papers in all fields:

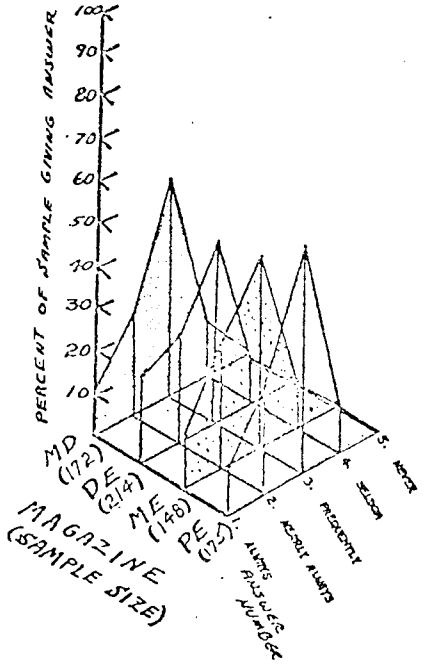


Figure 60. When reading trade publications, how often do you read technical papers you are interested in:

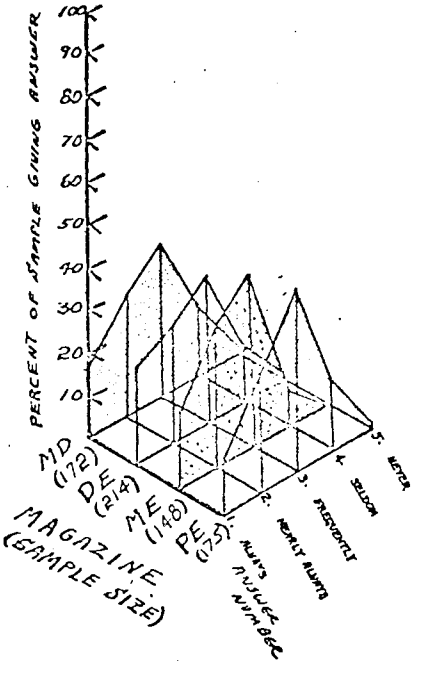


Figure 61. When reading trade publications, how often do you read technical papers related to your work:

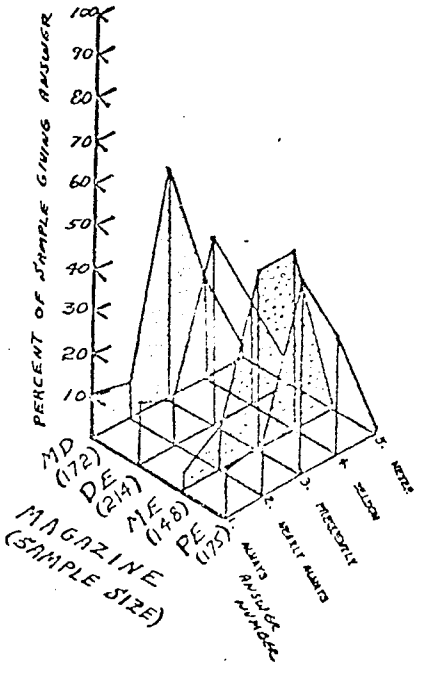


Figure 62. When reading trade publications, how often do you read advertising:

to their work. Nearly 45% of the designers that have access to the magazines read or nearly always read technical papers related to their work, while 15% of those with access to MD, DE, and PE and 8% of those with access to ME seldom or never read them. The homogeneity test shows that chi square equals 13.79 with 12 degrees of freedom.

Figure 62 (Question 71) presents data on the frequency that designers that have access to the magazines read advertising when reading trade publications. 25% of the designers with access to DE and PE always or nearly always read the advertising, while only 15% of those with access to MD and ME read the advertising that often. About 30% of the designers with access to the magazines MD, DE, and PE seldom or never read advertising, while 45% of those with access to ME seldom or never read advertising when reading trade publications. The homogeneity test shows that chi square equals 32.42**** with 12 degrees of freedom.

Figure 63 (Question 72) presents data on the question of whether or not there is sufficient information for the designer that has access to the magazines for the design of gears; and if not, how they would like to see the additional information presented. 84% of those with access to PE feel that there is sufficient information for the design of gears, while 71% of the designers with access to the other magazines feel that way. Method of solution is the most popular form of additional information with about 8% of the designers prefering this form. 7% of those with access to MD, DE, and ME prefer solved problems, while less than 1% of those with access to PE prefer this method. 4% of those with access to the magazines want to see listed equations to do calculations, while the alternative methods of additional information were not very popular. The homogeneity test shows that chi square equals 17.04 with 21 degrees of freedom.

Figure 64 (Question 73) presents data on the question of whether or not there is sufficient information for the designer that has access to the magazines for the design of linkages; and if not, how they would like to see the additional information presented. 66% of those with access to PE and 60% of the other designers with access to the magazines feel that there is sufficient information for the design of linkages. 14% of the designers would like to see a method of solution, while 9% of those with access to MD, DE and ME, and 5% of those with access to PE would like to see listed equations to do calculations as a means of introducing additional information. 14% of those with access to MD, 10% of those with access to DE and PE, and 7% of those with access to ME would like to see solved problems. The other methods of presenting additional information were not very popular. The homogeneity test shows that chi square equals 7.51 with 21 degrees of freedom.

Figure 65 (Question 74) presents data on the question of whether or not there is sufficient information for the designer that has access to the magazines to design cams; and if not, how would they like to see the additional information presented. About 60% of the designers with access to the magazines feel that there is sufficient information for the design of cams. 20% of those with access to ME would like to see method of solution, while about 13% of those that have access to the other magazines want this method. About 14% of the designers would like to see listed equations to do calculations, while 5% would like to see solved problems for additional information in cam design. The other methods were not very popular sources of additional information. The homogeneity test shows that chi square equals 17.59 with 21 degrees of freedom.

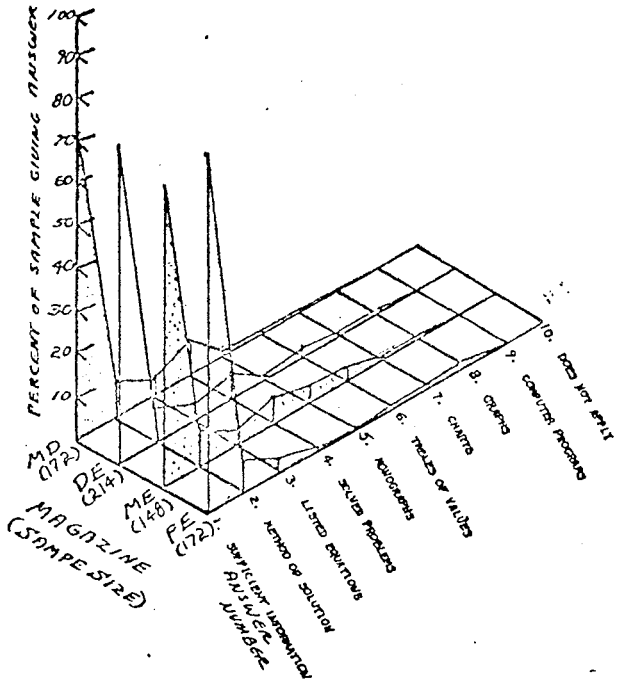


Figure 63. Do you find inadequate information in the design of Gears and how would you like to see it:

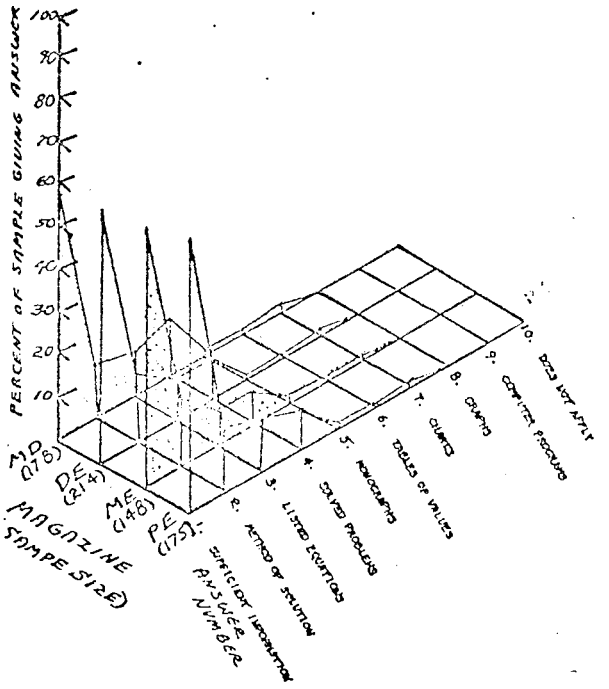


Figure 64. Do you find inadequate information in the design of Linkages and how would you like to see it:

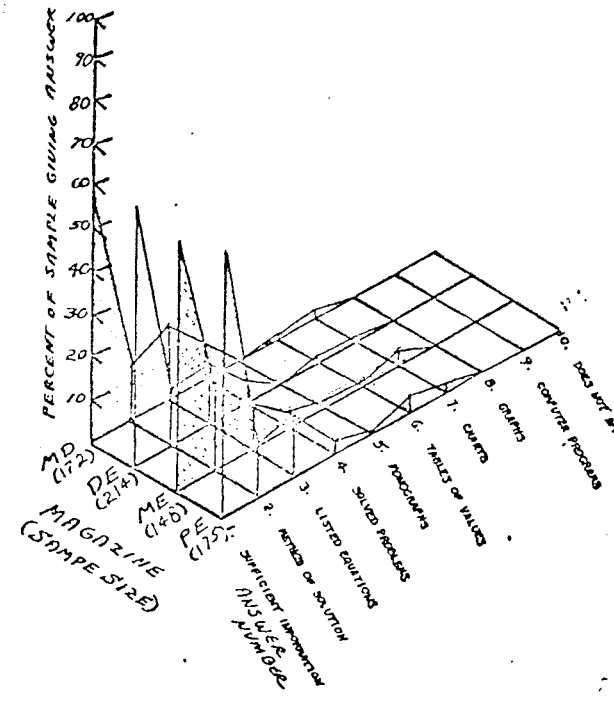


Figure 65. Do you find inadequate information in the design of Cams and how would you like to see it:

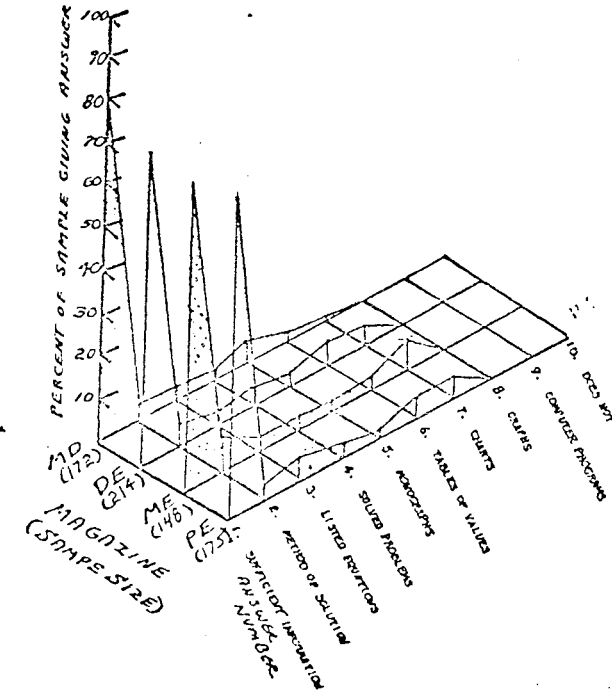


Figure 66. Do you find inadequate information in the design of Fasteners and how would you like to see it:

Figure 66 (Question 75) presents data on the question of whether or not there is sufficient information for the designer that has access to the magazines to design fasteners; and if not, how would they like to see the additional information presented. 75% of the designers that have access to the magazines feel that there is sufficient information for the designing of fasteners. The remaining 25% of the designers are fairly evenly distributed in their preference of methods for additional information. The homogeneity test shows that chi square equals 8.63 with 21 degrees of freedom.

Figure 67 (Question 36) presents data on the question of whether or not there is sufficient information for the designer that has access to the magazines to design power drive; and if not, how would they like to see the additional information presented. About 2/3 of the designers feel that there is sufficient information for the designing of power drive components. Listed equations to do calculations was the most preferred method for adding information with about 15% of the designers with access to the magazines preferring this method. 10% of the designers were looking for method of solution, while 5% were looking for solved problems. The other methods of adding information in the area of power drive design were not very popular. The homogeneity test shows that chi square equals 14.76 with 21 degrees of freedom.

Figure 68 (Question 77) presents data on the question of whether or not there is sufficient information for the designer that has access to the magazines to design seals; and if not, how would they like to see the additional information presented. 2/3 of the designers that have access to the magazines feel that there is sufficient information for the design of seals. 8% would like to see method of solution, 7% would

like to see solved problems, 5% would like to see listed equations to do calculations and charts, and 4% would like to see tables of values for any problem as methods of adding information in the area of seals design. The other methods of additional information were not very popular. The homogeneity test shows that chi square equals 13.58 with 21 degrees of freedom.

Figure 69 (Question 78) presents data on the question of whether or not there is sufficient information for the designer that has access to the magazines to design springs; and if not, how would they like to see additional information presented. Two of three designers with access to the magazines feel that there is sufficient information for the design of springs. 12% of the designers are looking for listing equations to do calculations and another 9% are looking for method of solution as a means of adding information in the area of spring design. The other methods were not very popular among the designers. The homogeneity test shows that chi square equals 14.90 with 21 degrees of freedom.

Figure 70 (Question 79) presents data on the question of whether or not there is sufficient information for the designer that has access to the magazines for the design of bearings; and if not, how would they like to see the additional information presented. Over 3/4 of the designers with access to PE feel that there is sufficient information for the design of bearings, as do 2/3 of the designers with access to the other magazines. Listed equations to do calculations was preferred by 11% of those with access to MD, DE, and PE and 6% of those with access to ME. 9% of those with access to MD and DE prefer method of solution, as do 6% of those with access to ME and 3% of those with access to PE. 5% of the designers prefer tables of values for any problem, while the other

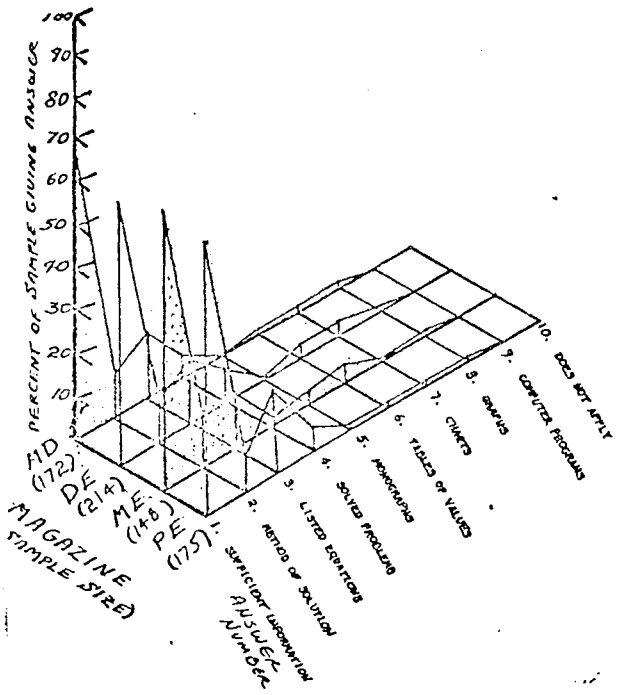


Figure 67. Do you find inadequate information in the design of Power Drive and how would you like to see it:

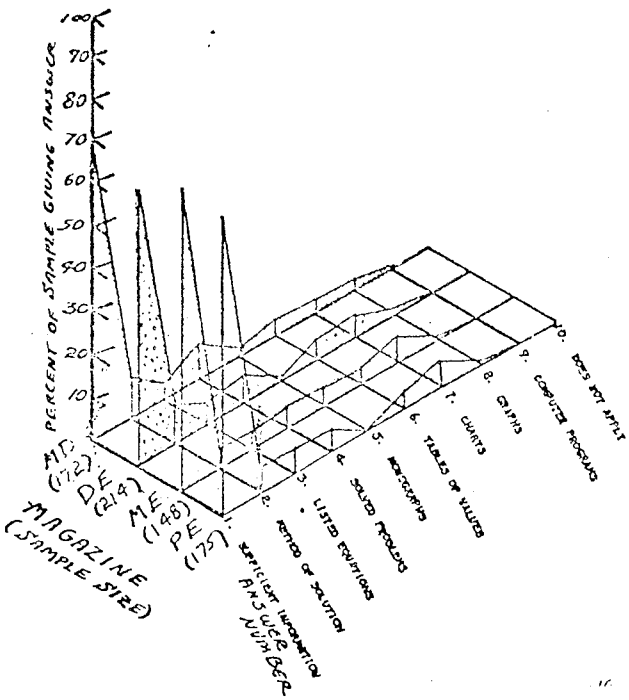


Figure 68. Do you find inadequate information in the design of Seals and how would you like to see it:

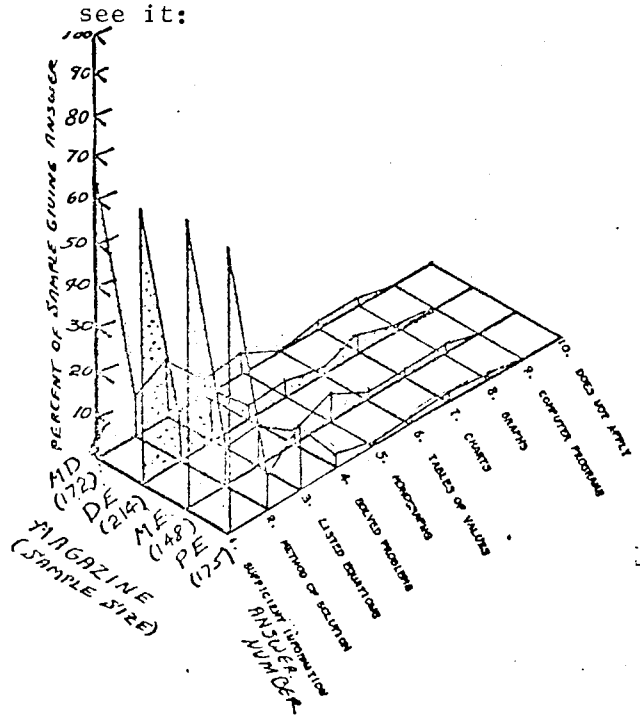


Figure 69. Do you find inadequate information in the design of Springs and how would you like to see it:

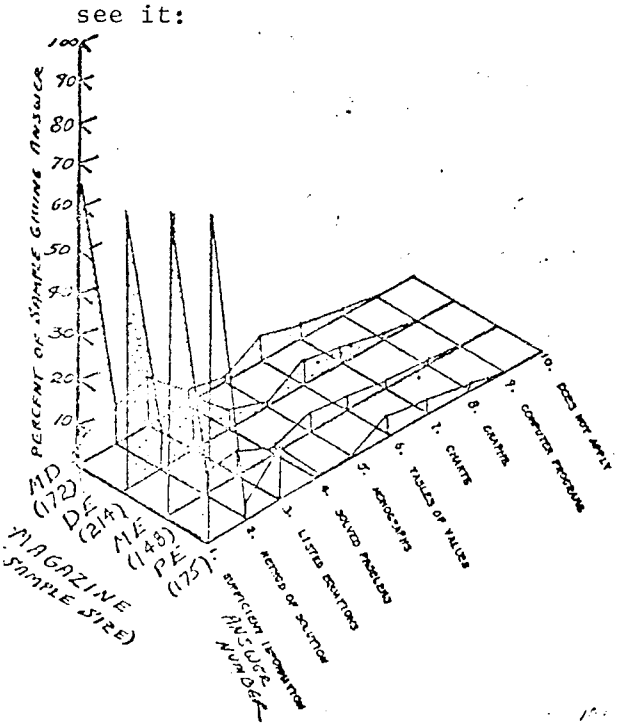


Figure 70. Do you find inadequate information in the design of Bearings and how would you like to see it:

methods of adding information in the area of bearing design were not very popular. The homogeneity test shows that chi square equals 22.59 with 21 degrees of freedom.

Figure 71 (Question 80) presents data on the question of whether or not there is sufficient information for the designer that has access to the magazines for the design of electromechanical (E-M) components; and if not, how would they like to see the additional information presented. 70% of those with access to MD, ME, and PE feel that there is sufficient information, while only 50% of those with access to DE feel this way. 25% of the designers with access to DE want to see method of solution, while 15% of the designers with access to the other magazines want to see the additional information presented in this manner. 17% of those with access to DE, 12% of those with access to PE, and 6% of those with access to MD and ME prefer listed equations to do calculations, while about 5% of the designers are looking for solved problems for the additional information. The other methods were not very popular. The homogeneity test shows that chi square equals 20.14 with 21 degrees of freedom.

Figure 72 (Question 81) presents data on the question of whether or not there is sufficient information for the designer that has access to the magazines for the design of fluid power and pneumatics; and if not, how would they like to see the additional information presented. About 75% of the designers feel that there is sufficient information for the designing of these components. 15% of the designers would like to see method of solution, while 6% of them would like to see solved problems. 6% of the designers with access to MD would like to see listed equations to do calculations, while none of the other designers prefer this

method. The other methods of adding information in the area of fluid power and pneumatics were not very popular. The homogeneity test shows that chi square equals 28.70 with 21 degrees of freedom.

Figure 73 (Question 83) presents data on the frequency that the designers that have access to the magazines read trade magazines. 39% of those with access to DE read trade magazines less than 1 hour/month, while only 12% of those with access to the other magazines read trade magazines less than 1 hour/month. 56% of those with access to MD, 50% with access to ME, 45% with access to PE, and 37% with access to DE read trade magazines 5 hours/month. 30% of those with access to PE and ME, and only 15 % of those with access to MD and DE read trade magazines 10 hours/month. About 10% of the designers read trade magazines for 20 hours/month or more often. The homogeneity test shows that chi square equals 64.01**** with 12 degrees of freedom.

Figure 74 (Question 84) presents data on the frequency that the designers that have access to the magazines read research reports. 68% of the designers with access to DE, 61% with access to MD, and 50% of those with access to ME and PE read research reports less than 1 hour/month. 41% of those with access to ME, 29% of those with access to PE, 24% of those with access to MD, and 17% of those with access to DE read research reports 5 hours/month. About 13% of the designers read these reports 10 hours/month, while less than 3% of the designers read research reports 20 hours/month or more. The homogeneity test shows that chi square equals 23.58*** with 9 degrees of freedom.

Figure 75 (Question 85) presents data on the frequency that designers that have access to the magazines read company catalogs. 68% of those with access to DE spend less than 1 hour/month reading company

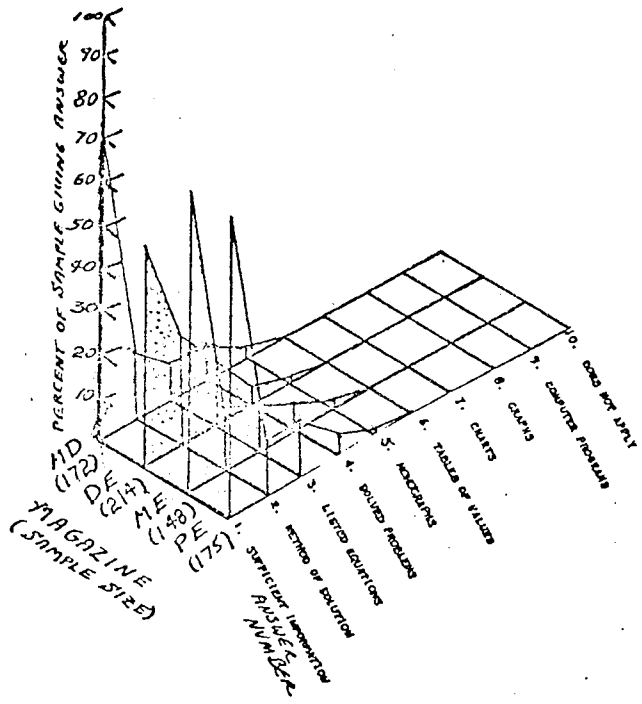


Figure 71. Do you find inadequate information in the design of Electromechanical Components and how would you like to see it:

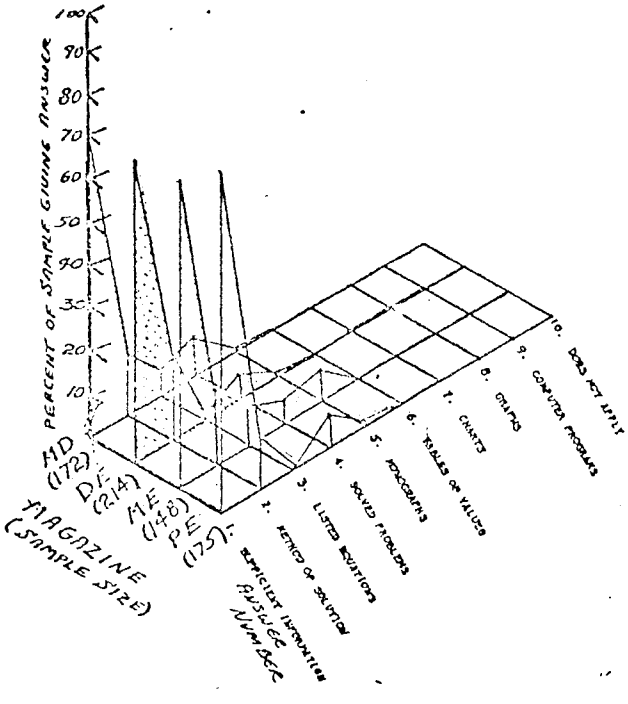


Figure 72. Do you find inadequate information in the design of Fluid Power and Pneumatics and how would you like to see it:

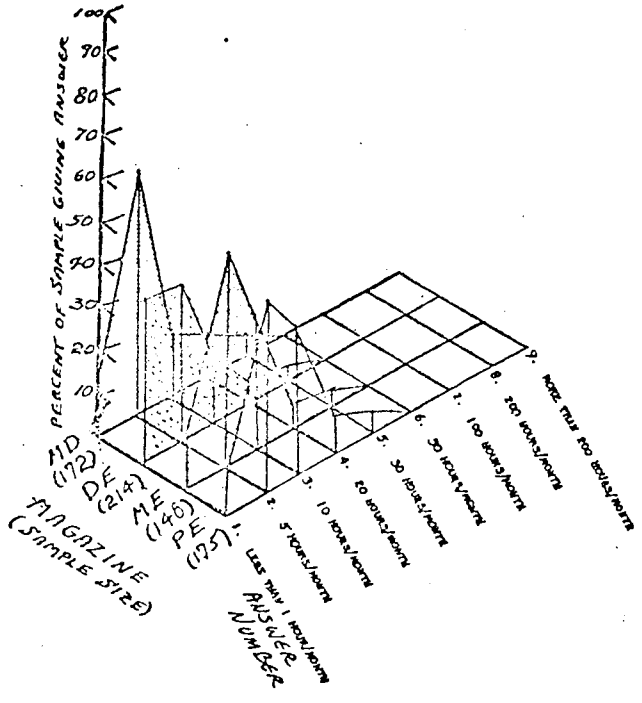


Figure 73. To keep up to date in design, what is the typical time you spend reading trade magazines:

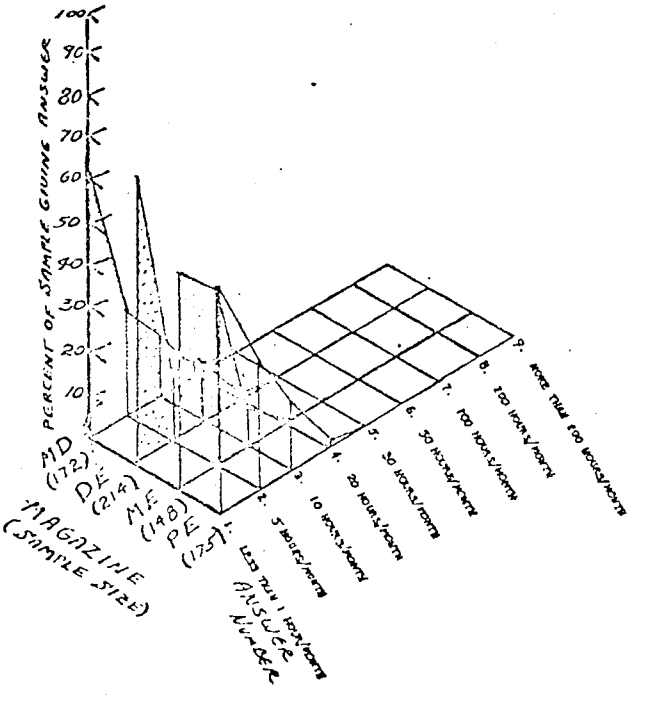


Figure 74. To keep up to date in design, what is the typical time you spend reading research reports:

catalogs, as do about 50% of the other designers. 35% of those with access to MD, ME, and PE read the catalogs 5 hours/month, while only 18% of those with access to DE read them that often. About 14% of the designers read company catalogs 10 hours/month or more. The homogeneity test shows that chi square equals 16.10 with 9 degrees of freedom.

Figure 76 (Question 86) presents data on the frequency that the designers that have access to the magazines go to workshops at universities. Over 80% of the designers spend less than 1 hour/month at these workshops, while about 8% spend 5 hours/month and 8% spend 10 hours/month going to workshops at universities. The homogeneity test shows that chi square equals 5.35 with 9 degrees of freedom.

Figure 77 (Question 90) presents data on the frequency that designers that have access to the magazines read technical papers. 56% of those with access to MD, 48% of those with access to DE, and 43% of those with access to ME and PE spend less than 1 hour/month reading technical papers. 33% of those with access to MD and DE read technical papers 5 hours/month, while less than 4% of the other designers read that often. 31% of those with access to ME read the technical papers 20 hours/month or more, as do 24% of those with access to PE read that often, while less than 8% of those with access to MD and DE read them 20 hours/month or more. The homogeneity test shows that chi square equals 206.23**** with 12 degrees of freedom.

This section analyzed the responses of the designers that have access to the magazines, but who do not read them. The responses indicate "working" conditions of the designers. Several of the "working" conditions were shown to affect which magazine the designers have access to.

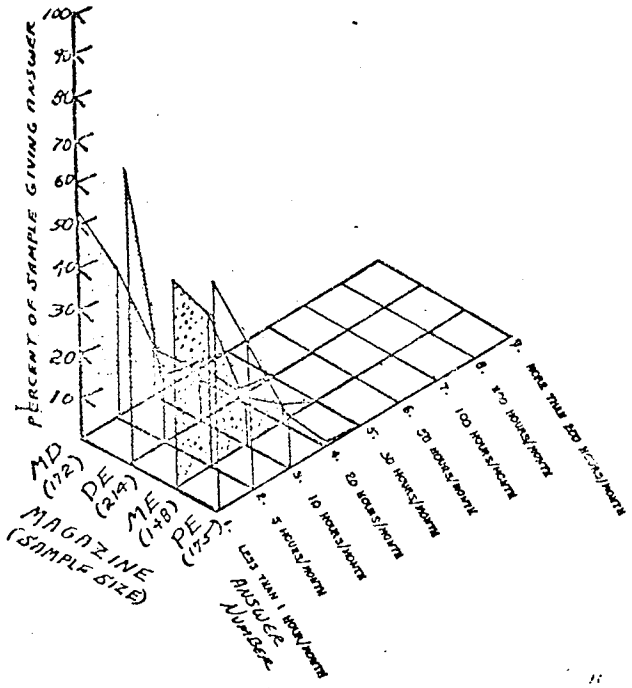


Figure 75: To keep up to date in design, what is the typical time you spend reading company catalogs:

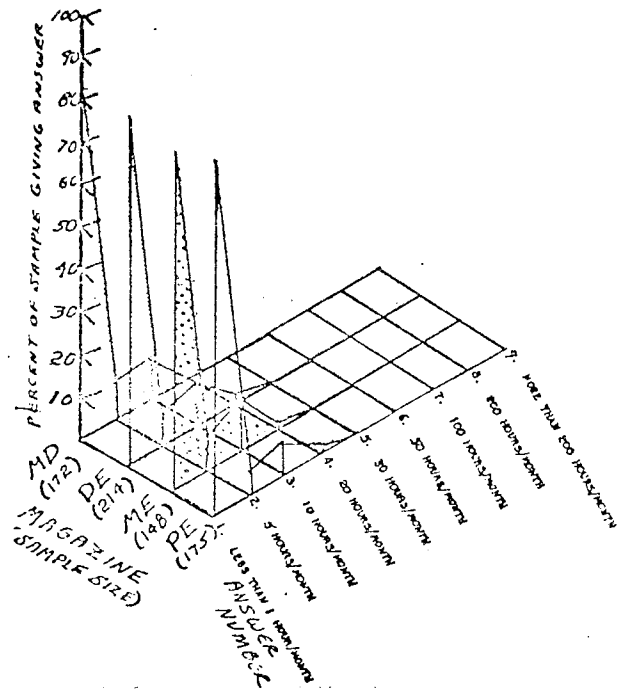


Figure 76. To keep up to date in design, what is the typical time you spend attending workshops at universities:

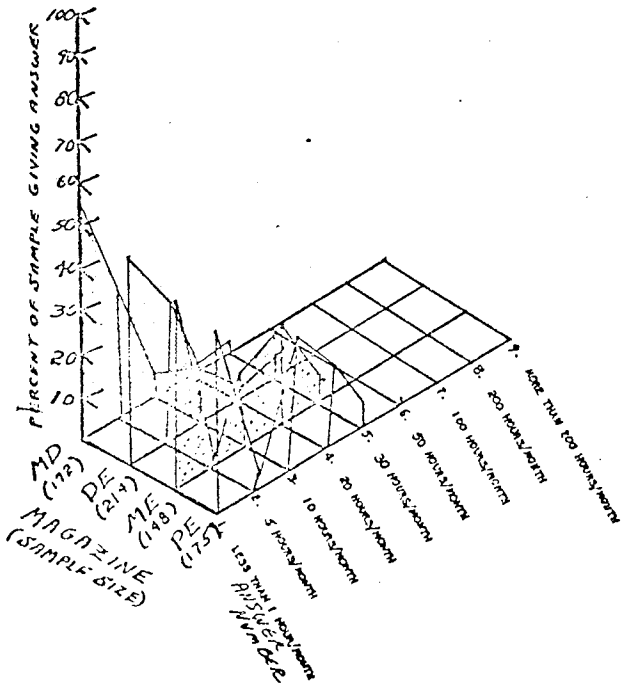


Figure 77. To keep up to date in design, what is the typical time you spend in reading technical papers:

The formal education of the designer effects which magazine he has access to, as does the frequency which he designs fluid power equipment. Reading advertising in trade publications and using commercially available components, both measures of the use of advertising, effect which magazine the designer has access to. The reading of trade magazines, the reading of research reports, and the reading of technical papers effect which magazine the designer has access to.

The importance of these findings will be discussed in the final chapter, Discussion and Conclusions.

This chapter analyzed the contents of the trade magazines that the designers rated as being the most accessible to them. This chapter also analyzed the "working" conditions of the designers that read the magazines and the "working" conditions of the designers that have access to the magazines. It was shown that there is a significant difference in the contents of the magazines, and that various "working" conditions effect which magazine the designers read and the magazines which the designers have access to.

The following chapter will show how a knowledge of these differences is important to the engineering manager. It will also show how a knowledge of the use of trade magazines by the designers may be useful to the manager in the manager's function in the transfer of technology process. Suggestions will be made to help the manager in his function of getting vital information to the designer's desk in a usable form.

CHAPTER V

DISCUSSION AND CONCLUSIONS

The final chapter will discuss the important findings that were presented in the Data Analysis chapter. This chapter will discuss the technical contents of the magazines in relation to the frequency that the various components are designed and the sufficiency of information on the design of the various components. The non-technical and over-all contents of the magazines will be discussed to determine if these trade magazines are transferring technical information to the designers in a usable form. The importance of these findings to the engineering manager will be discussed.

The use of advertising in the magazines will be discussed to determine if the numerous pages devoted to this purpose are serving a function to the designers or the engineering manager. This will be done by relating the amount of time the designers spend reading advertising to the frequency that the designers use commercially available components and to the frequency that the designers have other companies manufacture special components. The importance of these findings to the engineering manager will be discussed.

Some of the personal "working" conditions of the designers will be discussed. These personal "working" conditions will include the design responsibility, the length of time in design, and the formal education of the designers. The importance of these findings to the engineering

manager will be discussed.

Some of the various sources of additional information available to the designer will be discussed, as will some opportunities that the designers have available to them to keep them up to date in design. The importance of these findings to the engineering manager will be discussed.

The chapter will then draw some conclusions from the Data Analysis chapter and from the discussions in this chapter. Some specific conclusions will be derived by answering the research questions from Chapter III. Some general observations will be made from the data that was analyzed and from the process of researching this study. Some of the important findings to the engineering manager will be given in this chapter, as will topics for possible research.

Discussion

Magazine Contents - Technical Contents

Figure 1 of the Data Analysis chapter reveals that there are significant differences in the technical contents of the four magazines. Some of the relations among the responses to the sufficiency of available information for the design of various components (Table III), the technical contents of the magazines (Table IV), and the frequency with which the various components are designed (Table V) will be discussed.

The analysis of the technical contents of the magazines (Table IV) makes it apparent that many of the components are not given proper attention in the trade magazines. Gears, cams, linkages, seals, and springs are given very little attention, while power drive, bearings,

TABLE III

SUFFICIENT INFORMATION (%)

	READS				ACCESS			
	MD	DE	ME	PE	MD	DE	ME	PE
GEARS	81	78	73	71	71	75	71	84
LINKAGES	60	60	59	52	57	60	61	66
CAMS	65	61	60	59	57	61	59	63
FASTENERS	79	77	73	79	77	74	72	77
POWER DRIVE	67	69	57	65	65	60	66	65
SEALS	74	71	61	69	66	65	71	70
SPRINGS	72	70	70	70	64	64	68	68
BEARINGS	77	72	68	68	65	64	72	77
E-M COMPONENTS	68	57	58	71	69	52	70	70
FLUID POWER	71	72	60	70	70	73	72	79

TABLE IV

TECHNICAL BREAKDOWN (%)

	MD	DE	ME	PE
GEARS	2.12	0.00	3.30	5.74
LINKAGES	0.42	0.98	0.00	2.09
CAMS	0.53	0.00	1.37	0.00
FASTENERS	3.17	2.45	0.00	7.31
POWER DRIVE	8.78	11.27	2.75	9.14
SEALS	2.22	0.49	1.37	1.83
SPRINGS	3.60	0.00	0.00	4.44
BEARINGS	7.94	7.35	5.77	7.31
E-M COMPONENTS	5.50	12.25	8.52	5.48
FLUID POWER	20.53	40.69	9.62	20.10
OTHER TECHNICAL	45.19	24.51	67.31	36.55
TOTAL	100%	100%	100%	100%

TABLE V

FREQUENCY OF DESIGN (%)

	READS				ACCESS			
	MD	DE	ME	PE	MD	DE	ME	PE
GEARS	24	25	21	18	25	29	19	26
LINKAGES	51	56	44	48	25	28	19	24
CAMS	20	30	20	20	48	43	42	42
FASTENERS	56	53	57	60	52	52	48	54
POWER DRIVE	40	38	33	40	43	40	38	40
SEALS	35	35	35	35	34	42	31	26
SPRINGS	45	42	42	38	43	42	37	42
BEARINGS	45	37	44	37	44	44	37	46
E-M COMPONENTS	30	40	30	30	32	35	32	31
FLUID POWER	27	38	30	30	17	36	22	18

and electromechanical components are given only a light amount of attention, with fluid power equipment being the only component given adequate attention.

More designers feel that there is sufficient information for the design of gears than they do for the other components, and yet, this component is given the least amount of attention in the trade magazines. It is apparent that the designers are obtaining information on gear design from other sources. Sources that may be supplying this information are handbooks, textbooks, or company standards.

It is important for the engineering manager to know not only what sources his designers use but also what sources are supplying the designers with the information that they need. Allen (1966)[1] found that the most important aspects of his data "lies in the fact that the channels used with the greatest amount of frequency are not the ones that provide the greatest number of acceptable ideas. There is a serious misalignment between the quality of the ideas generated through the channels studied, and the frequency with which these channels are used by engineers."

Another important finding to the engineering manager is the fact that the designers that have access to the magazines use more additional sources of information than do those that read the magazines. Figures 19, 20, and 21, for those that read the magazines, and Figures 56, 57, and 58, for those with access to the magazines, show that the designers with access to the magazines use 20 or more handbooks, textbooks, and company standards more frequently than those that read the magazines. Because the designers are usually under a time constraint and because the designers are usually "judged (performance wise) by concrete output;

not on the number of journals or trade magazines read,"[2] the manager must have the sources of information that are useful to the designers available to them. It is therefore important for the manager to know what sources of information are available and which ones are most useful to the designers' tasks.

The designers feel that the information available to them is not sufficient for the design of most components (Table III), but it is especially true for the design of cams and linkages. The designers handle the lack of adequate information for the design of these components very differently. Table V shows that while about 45% of the designers with access to the magazines design cams at least once every three months, only about 25% of those that read the magazines design cams that frequently. This indicates that the designers of cams do not want to "waste" their time reading trade magazines. In contrast to this situation, 25% of those with access to the magazines design linkages at least once every three months, while over 50% of the designers that read the magazines design linkages that frequently. This implies that the designers of linkages are desperately searching for information to help them but are unable to find it.

These findings are important to managers at all levels because the lack of available information may place severe limitations on the design of these components. This situation would be important to management because the sales department, marketing department, and the production department would all have to know what could be designed and what could not be designed.

Management may have to try to influence the publishers of trade magazines, handbooks, textbooks, and other technical publications to

introduce a high quality publication that has technical information readily available to the designer in a usable form. This influence could be in the form of a grant, or offering technical assistance, or even threatened discontinuance of the subscription to the magazines and other publications. An interesting topic for research would be the possibility of a publication conducted as a joint venture between the academic and professional communities. This publication could draw on a theoretical basis for a particular design technique from the academic community and yet have the advantage of drawing on the practical implications of the design from the professional community.

Magazine Contents - Non-Technical Contents

Figure 2 of the Data Analysis chapter reveals that there are significant differences in the non-technical contents of the magazines. The heavy use of Mechanical Engineering for miscellaneous purposes is largely due to the fact that this magazine represents the American Society of Mechanical Engineers and contains the news of the society's meetings, news of coming events and design shows, and other society news. Of importance to the designers and their managers are the technical abstracts included in this magazine. Therefore even though the magazine may not contain articles that are directly usable by the designer, the magazine does contain a great deal of references to technical information. The heavy use of Product Engineering for the presentation of trends and new products is important to the manager because it allows the designers to see what is going on in the field of design around them.

Over-All Contents

Figure 3 of the Data Analysis chapter reveals that there are significant differences in the over-all contents of the magazines. The top rated trade magazines used in this study do not emphasize technical material. The limited information that is in these magazines is difficult to locate when the designers are searching for a specific topic. This is so because there is no referencing of the material and because the designers must search through numerous pages of non-technical (including advertising) to find technical information. Rosenbloom and Wolek (1970)[3] found that 27% of the engineers use trade magazines while increasing their general competence, yet only 8% of the engineers use the trade magazines when specifically searching for information. This concurs also with the findings of Scott (1959)[4] who found that the main function of the technical literature is not that of a reference source for consultation, but a primary source of stimulation.

Although these magazines appear not to transfer much technical information, Scott's findings indicate that the magazines may stimulate the designers enough to search for information elsewhere. A knowledge of the importance of the value of this stimulation to the engineering manager would be useful in determining the utilization of trade magazines. Unfortunately, there was no available literature on this topic, therefore, it would be a possible area for research that could prove invaluable to the manager.

The magazines are heavily advertising-oriented except for Mechanical Engineering. The lack of emphasis on advertising and a heavy emphasis on non-technical (mostly miscellaneous) contents is due to the fact that this magazine is a society publication, and as such, it is published for

the benefit of the society's members and is not 'published for profit.' This agrees with the definitions of the various types of business publications that were described by Houghton.[5]

Advertising

The study will now discuss the use of advertising by the designers to determine if the large portions of the commercially published trade magazines devoted to this purpose are serving a need of the designers. It must be remembered that this is not consumer advertising but it is industrial advertising. "Many producers of goods and services are themselves consumers; they need raw materials, supplies of all kinds, machinery, and other equipment to do their job."[6]

Although the readers of Design Engineering do more reading of the advertising (Figure 25) than those that read the other magazines, they use commercially available components (Figure 17) and have other companies manufacture special components (Figure 18) less than the readers of the other magazines do. A similar situation exists for the designers with access to these magazines. Only 21% of those that read Mechanical Engineering always or nearly always read the advertising, while 55% of the readers of this magazine always or mostly use commercially available components.

The use of commercially available components and the use of having other companies manufacture special components as measures of the utilization of advertising suggests that the designers that do the most purchasing must find their information in other sources. Many of the designers are probably used to buying certain products from the same companies year after year without ever evaluating the possibility of

purchasing from other companies. The data indicates that the designers' advertising needs are not being satisfied by the trade magazines. That is, although many designers use products and services of other companies, the designers do not locate these products in the trade magazines.

A true measure of the usefulness of industrial advertising is a difficult task.

> Advertising and sales are not as directly related in industrial advertising as they are in consumer advertising. With certain consumer products it is not unusual for a consumer to see an advertisement and go directly out and buy it. This direct relationship does not usually hold true for industrial buyers. Most industrial purchases are costly and therefore more consideration is given to the purchase.[7]

This lag between the time the advertisement is made and the time that the designer or engineering manager purchases the product or machine makes the usefulness of the advertisement difficult to measure.

Personal "Working" Conditions

The personal "working" conditions of the designers to be discussed will include the design responsibility, the formal education, and the length of time in the design field for the designers. The readers of Mechanical Engineering are much more involved with stress responsibility than are the readers of the other magazines, who are very heavily involved with design responsibility in mechanisms. There was also a significant difference in the education levels of the designers. This supports an earlier study by Hoyt (1962)[8] who found that the reading habits of scientists and engineers engaged in research and development are readily differentiated by academic attainment and field of academic discipline (M.E., Chem, E.).

It is interesting to note there are not any readers of Mechanical Engineering, the magazine read by the highest number of educated designers, that have been in design for over 25 years, while at least 10% of the readers of the other magazine have been in design that long. This is important to the manager only if he feels that it is important to keep his highly educated people in design. It seems plausible that an engineering manager would benefit from having some college graduates remain in design if only to handle some of the more difficult design problems. The "technological gate-keeper" concept discussed by Firdoia (1968)[9] and Allen (1966)[10] implies that it is necessary to have a highly educated person to serve in this capacity. In large organizations, Beiber (1968)[11] goes as far as to suggest that specific technology transfer activities can be organized as staff functions. Allen (1966)[12] states that technologists as a group do not seem particularly motivated to keep up to date in their field, therefore, these opinion leaders serve a crucial function in the learning of new developments and communicating them to their colleagues.

It is indeed normal for highly educated designers to go into management or technical sales, but it appears that the manager must motivate some of these highly educated designers to remain in designing to serve as opinion leaders, as well as working on the more difficult design problems.

Sources of Additional Information

Designers that have access to the magazines use handbooks, textbooks, and company standards more extensively than the designers that read the magazines. It appears that these additional sources may be

better organized for finding the solutions to specific design problems than the trade magazines are. This appears to be so because the trade magazines have no reference system to help the designer find specific information. However, these handbooks, textbooks, and company standards are not published as frequently as the trade magazines and therefore they may not be supplying the most current information to the designer. It is not only the responsibility of the manager to get technical information to the designer, but it must be the most current information.

It may be necessary for the managers of several large organizations throughout the United States to let the editors and publishers of the magazines and other technical literature know when there are design problems that the literature cannot solve and what areas of design are deficient in technical information. It would then be the responsibility of these publishers to find the needed information. It would be possible then to get current information on various design components to the designers that need this information. It is apparent that the managers must first know what design areas are in most need of this type of approach.

Opportunities to Upgrade Technical Knowhow

These opportunities to upgrade the technical knowhow of the designers include reading research reports, reading company catalogs, attending workshops at universities, and reading technical papers. These opportunities are used to a greater degree by the designers that read and have access to Mechanical Engineering than the other magazines. This supports the statement by Rosenbloom and Wolek (1970)[13] that "a man with a high degree of commitment tends to pursue his formal education further

and to make education a continuing process (i.e. joining professional societies, attending meetings, reading technical papers)."

Conclusions

This study will now answer the research questions asked in Chapter III. It will then point out some general observations from the data and from researching this study, along with some implications for management.

Answers to the Research Questions

1. Wich magazines are most accessible to the designers? The magazines that are the most accessible to the designers are listed in Table II of the Data Analysis chapter. Only the top six magazines out of the seventy-two listed in Part IX of the Questionnaire were accessible to a large number of designers.

2. Which magazines are read by the most designers? The magazines that were read by the most designers are shown in Table II of the Data Analysis chapter. The magazines that are read by the designers are rated nearly the same as those with access to the magazines. Although no statistical test of correlation was conducted, it is rather obvious that from Table II that there is a strong positive correlation between the magazines that are read and the magazines that the designers have access to. The table shows that nearly 50% of the designers read some of the magazines that they have access to, while only 15% of the designers read other magazines that they have access to.

This implies that some designers may read a magazine because it happens to be lying around and not because they are searching for information for a specific purpose. This somewhat haphazard approach to

reading trade magazines can be greatly influenced by managements selection of magazines to be accessible. This approach may indeed prove to be a viable method of increasing the general competence of the designers.

Although this method may help the designers brush up in their field, or even become familiar with a new field, it probably is an ineffective method for solving designers' immediate needs. To find this needed information it appears that the designers are relying on the use of handbooks, textbooks, and company standards because they are referenced, thus making the information easier to locate than in the trade magazines. However, much of the information in these additional sources is dated by as much as five or ten years, therefore possibly being of no use to the designer even though it is readily available.

3. Is there significant differences in the contents of the magazines? Figures 1, 2, and 3 of the Data Analysis chapter show that there are significant differences in the Technical contents, the Non-Technical contents, and the Over-All contents of the magazines, respectively. Figure 1 shows that the magazines put different emphasis on the various design components. An engineering manager's knowledge of this finding could help in the selection of the magazines that match the designers' needs with available information that is useful to the designers.

Figure 2 shows that the magazines put different emphasis on the non-technical contents. This finding is probably not as important to the engineering manager as the finding on the difference in emphasis on the technical contents. However, many of these pages contain information on new products and trends in the field of design that may help the designers become aware of what is going on in the field of design outside

their organization.

Figure 3 shows that the magazines put different emphasis on the over-all contents of the magazines. This finding is rather disturbing, especially for the engineering manager, since many designers are given these magazines by the manager to help them solve technical design problems. Many managers do not take the time to read these magazines before they distribute them to the designers and therefore may not know what little technical material that they contain. Yet they are relying on these designers to design the component with the aid of the magazines. Rather than relying on the reputations of these 'technical' magazines, the manager must have facts concerning the contents of the magazines. Although this study will bring attention to the managers about the situation that exists, a great deal more research is necessary to encompass the technology transfer process.

4. Do various "working" conditions affect which magazines that the designers read? It was shown that various "working" conditions of the designers do affect which magazines they read. The personal "working" conditions of the designers that affect which magazines they read are their design responsibility, their formal education, and the length of time they have been in the design field.

The frequency that designers use commercially available components and the frequency that they have other companies manufacture special components affect the magazine that they read, as does the amount of time spent reading advertising.

The frequency of cam design and the adequacy of information for the design of fasteners and fluid power equipment affect which magazines the designers read. It is important for the manager to know how often

his designers are designing various components and if there is sufficient information available for designing these components. If there is not sufficient information available, it is then the responsibility of the manager to find the methods of presentation of additional information that the designers would like to see. The sources of information, other than trade magazines, that affect which magazines the designers read are the number of textbooks used, and the amount of time the designers spend going to workshops at universities and the amount of time that they spend reading technical papers.

The survey of the related literature has mentioned that designers that read technical papers more often than most designers have a high degree of commitment and would therefore be more inclined to make education a continuous process. These are the types of people that the managers would be interested in sending to the workshops, technical meetings, and conferences.

5. Do various "working" conditions affect which magazines that the designers have access to? It was shown that the various "working" conditions of the designers do affect which magazines the designers have available to them. The only personal "working" condition that affects which magazines the designers have access to is the formal education of the designers. The magazines to which the designers have access to are also affected by the amount of advertising that is read and the frequency that the designers use commercially available components.

There were significant differences in both the frequency of design of fluid power equipment and the sufficiency of information for the design of this equipment. This implies that the designers of this equipment would read the magazines that they have access to if the magazines

contained information on the equipment in the form of presentation they are looking for. Other sources of information that affect which magazines the designers have access to are the amount of time spent reading trade magazines, reading research reports, and reading technical papers.

Most designers do not buy these magazines themselves, but they have them supplied by the companies that they work for. Therefore most designers do not have much control over which magazines that they have access to. The control is usually the responsibility of the engineering manager or supervisor.

The manager must know what the designers' capabilities are, what their limitations are, and what their sources of information are. The manager must also know what information is available, what sources this information is available in, and what form the designers would like to see this information in. It is the matching of the designers' information needs with the available information that puts the engineering manager in the position of being a 'valve' in the technology transfer process.

General Observations from the Study

(1) It appears that the trade magazines are not providing technical information to the designers in a usable form.

(2) Since the information that is needed by the designers is not found in the trade magazines, the designers must resort to the use of handbooks, textbooks, and other additional sources of information, most of which provide dated information.

(3) It appears that sufficient information for the design of cams

and linkages cannot be found using all available sources of information. This places severe limitations on the sales and production of products that contain these components.

(4) It appears that the trade magazines are not providing the industrial advertisements that the designers are using in their industrial purchasing.

(5) The engineering manager may be instrumental in bringing about changes in the transfer of technical information to the designers.

Management Limitations

(1) Management is usually responsible for the magazine subscription policy of the company. Therefore management must know which magazines are going to help his designers solve their designing problems. Many engineering managers assume that these trade magazines are beneficial to their designers. They 'blindly' subscribe to the trade magazines and put them in the designers' hands and expect the designers to have the information that they need.

The manager must know what the designers' information needs are and also what information is available. To perform this function management must keep itself abreast of the available sources of information.

(2) Management can create special staff positions to aid them in the flow of technical information from the source of the information to the designers' desks in a usable form. This could be an entire department in a large corporation or it could be a single person in a smaller organization. Regardless of the size of the company, this person or

staff would function as opinion leaders by searching out available information and making the information that is needed by the designers accessible to them in a usable form.

(3) This role of opinion leader is one that must be filled by people that are highly educated, self-motivated, and people that communicate well at all levels. They must be able to separate 'the wheat from the chaff' to get the usable information for the designers.

(4) Top-management is in a position to hold lower- and middle-management accountable for the technology transfer process. Lower- and middle-management are in turn in a position to hold the designers accountable for the design, development, and location of new design techniques. However, top-management is ultimately responsible for this function and may therefore take whatever measures are necessary to carry out this function.

The discussions have been specifically aimed at the engineering manager responsible for design. Although this was the focus of the study, many of the managerial implications that were discussed can apply to a number of different settings. All managers are faced with the problem of getting information of a specific nature to the people that need that information in a usable form. To perform this function the manager must have a knowledge of the information needs and the information that is available. He must have a knowledge of the information channels and the effectiveness of the channels.

No one managerial method can be expected to perform the transfer of technology function in all organizations, or all departments of the same organization, or even in the same department at different times. What is important for the manager to realize is that there are a

number of managerial methods and structures that are available to him. It is a true challenge to management to select the method and structure that are best suited to meet the needs at hand. In order for management to chose a method or structure that would be useful, they must have a knowledge of the variables that affect the situation.

FOOTNOTES

[1]Thomas J. Allen, "The Differential Performance in Information Channels in the Transfer of Technology," 1966, in Factors in the Transfer of Technology by William H. Gruber and Donald G. Marguis (M.I.T. Press, 1969), p. 44.

[2]Arthur G. Erdman and Dennis E. Ferguson, "Technology Needs of the Machine Designer," Proceedings of the 1st Design Technology Transfer Conference of ASME, New York, New York (1973), p. 502.

[3]Richard S. Rosenbloom and Francis W. Wolek, Technology and Information Transfer: A Survey of Practice in Industrial Organizations (Boston: Harvard Press, 1970), p. 36.

[4]Christopher Scott, "The Use of Technical Literature by Technologists," IEEE Transactions on Engineering Management, Vol. EM-7-8, No. 3 (1959), p. 81.

[5]Bernard Houghton, Mechanical Engineering: The Sources of Information (London, England: Archon Books and Clive Bingley, 1970), p. 101.

[6]J. D. Burke, Advertising in the Marketplace (The Gregg/McGraw-Hill Marketing Series, 1973), p. 54.

[7]Emil Hofsoos, What Management Should Know About Industrial Advertising (Houston: Gulf Publishing Company, 1970), p. 3.

[8]J. W. Hoyt, "Periodical Readership of Scientists and Engineers in Research and Development Laboratories," IEEE Transactions on Engineering Management, Vol. EM-9-10, No. 3 (1962), p. 74.

[9]A. Firdoia, "The Technological Gate-Keepers and Their Role in R & D Laboratories," M.S. Thesis (M.I.T. Press, 1968) in Thomas K. Shotwell, "Information Flow in Research Laboratories," IEEE Transactions on Engineering Management, Vol. EM-18, No. 1 (1971), p. 32.

[10]Allen, p. 144.

[11]Herman Beiber, "Technology Transfer in Practice," IEEE Transactions on Engineering Management, Vol. EM-16, No. 4 (1969), p. 147.

[12]Allen, p. 145.

[13]Rosenbloom and Wolek, p. 55.

BIBLIOGRAPHY

Allen, T. J. "The Utilization of Information During R & D Proposal Preparations," M.I.T. Sloan School of Management, Working Paper No. 97-64, 1964, in J.M. Laderdorf, "Information Flow in Science, Technology, and Commerce," Special Libraries, Vol. 61, 1970, p. 215-222.

Allen, T. J. "The Differential Performance in Information Channels in the Transfer of Technology," 1966, in Factors in the Transfer of Technology by W.H. Gruber and D.G. Marquis, Boston, M.I.T. Press, 1969, p. 137-154.

Baird, R. N. and A. T. Turnbull. Industrial and Business Journalism. Philadelphia: Chilton Co., Book Division, 1961.

Burke, J. K. Advertising in the Marketplace. The Gregg/McGraw-Hill Marketing Series, 1973.

Cloud, G. H. and W. T. Know. "Information Research-A New Tool," Fifth World Petroleum Congress, Paper 15, in Stewart, J.M., "Techniques for Technology Transfer Within a Business Firm," IEEE Transactions on Engineering Management, Vol. EM-16, No. 3, 1969, p. 103-111.

Davis, R. A. "How Engineers Use Technical Literature," Chemical Engineering Progress, Vol. 61, No. 3, p. 30-35.

Erdman, A. G. and D. E. Ferguson. "Technology Needs of Machine Designers," Proceedings of the 1st Design Technology Transfer Conference of ASME, New York, New York, 1973, p. 501-504.

Firdoia, A. "The Technological Gate-Keepers and Their Role in R & D Laboratories," M.S. Thesis, M.I.T. Press, 1968, in Shotwell, T.K. "Information Flow in Research Laboratories," IEEE Transactions on Engineering Management, Vol. EM-18, No. 1, 1971, p. 27-33.

Giberson, W. E. "The Management of Technology in an Advanced Project-The Case of Surveyor," IEEE Transactions on Engineering Management, Vol. EM-16, No. 3, 1969, p. 125-130.

Hall, R. H. Organizations-Structure and Process. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1972.

Hofsoos, E. What Management Should Know About Industrial Advertising. Houston: Gulf Publishing Company, 1970.

Houghton, B. Mechanical Engineering: The Sources of Information. London, England: Archon Books and Clive Bingley, 1970.

Hoyt, J. W. "Periodical Readership of Scientists and Engineers in Research and Development Laboratories," IEEE Transactions on Engineering Management, Vol. EM-9-10, No. 3, 1962, p. 71-76.

Moore, J. R. "The Technology Transfer Process Between a Large Science-Oriented and a Large Market-Oriented Company-The North American Rockwell, Challenge," IEEE Transactions on Engineering Management, Vol. EM-16, No. 3, 1969, p. 111-116.

Rosenbloom, R. S. and F. W. Wolek. Technology and Information Transfer: A Survey in Industrial Organizations. Boston: Harvard University, 1970.

Scott, C. "The Use of Technical Literature By Technologists," IEEE Transactions on Engineering Management, Vol. EM-7-8, No. 3, 1959, p. 80-84.

Shotwell, T. K. "Information Flow in Research Laboratories," IEEE Transactions on Engineering Management, Vol. EM-18, No. 1, 1971, p. 27-33.

Soni, A. H. and L. A. Torfason. "State of the Art in Machine Design Technology at the Practice Level: An Extensive Survey," Proceedings of the 1st Design Technology Conference of ASME, New York, New York, 1973.

Steiner, G. A. and J. O. Vance. "Selected Papers from a Seminar on The Management of Technology Transfer, UCLA, 1968, Introduction," IEEE Transactions on Engineering Management, Vol. EM-16, No. 3, 1969, p. 99-103.

Stewart, J. M. "Techniques for Technology Transfer Within a Business Firm," IEEE Transactions on Engineering Management, Vol. EM-16, No. 3, p. 103-111.

Wood, D. N. and L. Hamilton. The Information Requirements of Mechanical Engineers. London, England: London Library Association, 1967.

APPENDIX A

SURVEY FORM TO INVESTIGATE THE NEEDS OF MECHANICAL DESIGNERS TECHNOLOGY TRANSFER IN MACHINE DESIGN

OKLAHOMA STATE UNIVERSITY

SURVEY FORM TO INVESTIGATE THE NEEDS OF MECHANICAL

DESIGNERS TECHNOLOGY TRANSFER IN MACHINE DESIGN

OKLAHOMA STATE UNIVERSITY

TO YOU THE DESIGNER

This questionaire is intended to be general and suitable for Mechanical Designers. Some of these questions may not pertain to your particular work or you may feel reluctant to answer them. If this is the case, mark this question with a zero (0).

Do not put your name of the form, all information about individuals and companies will be hled in the strictest confidence.

Please put the number in the box provided which you feel best answers the question in your opinion.

Do not hesitate to elaborate on any questions.

○ 1	Your title in the company: (1) Conceptual Designer (2) Chief Designer (3) Associate Designer (4) Project Designer (5) Front-line Designer (6) Illustrative Designer (7) Senior Designer (8) Other _____
○ 2	Which of the following best decribes the design responsiblity where most of your time is spent: (1) Stress (2) Mechaniam (3) Control (4) Fluid Mechanics (5) Aerodynamics (6) Dynamics and Vibration (7) Thermodynamics (8) Bearings & Lubrication (9) Other _____
○ 3	Formal Education: (1) HS (2) AS (3) BS (4) MS (5) Ph D
○ 4	Other Education: (1) Correspondence School (2) Self Taught (3) Courses at Work (4) Night School (5) Special Course (6) Local University Course (7) Other_____
	For each of the following three questions, fill in a number from the time category at the right:
○ 5	Total time you have worked in Design:
○ 6	How long have you worked in your present field:
○ 7	How long do you feel Designers stay in Design:
	(1) 1 year (2) 1-3 years (3) 3-5 years (4) 5-10 years (5) 10-15 years (6) 15-20 years (7) 20-25 years (8) 25-30 years (9) More than 30 years
○ 8	Do you plan to: (1) Stay in Design (2) Become Chief Designer (3) Become Supervisor in Design (4) Go into Management (5) Go into Production Department (6) Other_____
○ 9	Is most of your work done: (1) by yourself (2) with 1 or 2 others (3) with 3-5 others (4) with 5-10 others (5) with 10-15 others (6) with 15-20 others (7) with 20-50 others (8) with 50-100 others (9) more than 100 others
○ 10	Is your work done in: (1) Research (2) Development (3) Production (4) Other_____
	For each of the following Design Projects, fill in one number from the table at the right which best describes the equipment you Design. Do you Design:
○ 11	Totally New Equipment:
○ 12	Major Redesign of Equipment:
○ 13	Minor Redesign of Equipment:
○ 14	Trouble Shooting:
	(1) Systems of many large machines (2) Systems of 2 or 3 large machines (3) Single large machine (4) Several intermediate sized machines (5) One intermediate size machine (6) Several small machines (7) Single small machine (8) Design of component groups (9) Single Component (0) Don't Design these
○ 15	When looking for information would you prefer: (1) Know the method and do you own calculations (2) List of equations and do your own calculations (3) Graphs and charts (4) Tables of values (5) Computer programs (6) Solved problems (7) Many of these (8) None of these

Which of the following computational aids do you use:

16 Computers with Canned Programs
17 Computers with your own programs:
18 Desk Computers
19 Desk Calculators
20 Pocket Calculators
21 Slide Rule

(1) Always
(2) Mostly
(3) Often
(4) Seldom
(5) Never

How frequently do you Design the following Components. (Fill in the appropriate number from the list at the right into the box provided.

22 Gears
23 Cams
24 Linkages
25 Fasteners
26 Power Drive
27 Seals
28 Springs
29 Bearings
30 Electromechanical Components
31 Fluid Power Equipment
32 Other_____

(1) Every week
(2) Once every month
(3) Once every three months
(4) Twice per year
(5) Once per year
(6) Once in five years
(7) Seldom
(8) Never

33 Is the majority of your Design based on: (1) Inventiveness and creativity (2) Mathematical Model based on firm Scientific Principles (3) Normal Engineering assumptions (4) Brute Force (5) Many of these (6) All of these

34 Do you Design for: (1) Mass production greater then 10,000 (2) Limited mass production greater then 1000 (3) Limited production greater than 100 (4) 10-100 (5) 3-10 (6) 2 (7) 1

35 How often do you check performance of a machine before manufacture:
36 Do you use commerically advailable components:
37 Do you have other companies manufacture special components:
38 Does cost limit the quality of a machine being designed:
39 Does time limit the quality of a machine being designed:
40 Does inadequate information of Design loading limit the quality:
41 Does inadequate design knowledge limit the quality of a machine:
42 How often have you made compromises because of a lack of information:
43 How often do you life-test a machine before and after manufacture:

Pick the answer from below that best answers the questions to the left, then write it in the space provided.

(1) Always
(2) Mostly
(3) Often
(4) Seldom
(5) Never

How much of your time is spent:

44 Supervising other Designers
45 Supervision of Draftsmen:
46 Supervision of Technicians:
47 Doing actual Designs:
48 Drawing:
49 Doing other Technical Work:
50 Learning new Techniques essential to your Design:
51 Learning new Techniques not essential to your present Design:
52 Reading:
53 Other:

Fill in the number from the table below which gives the percent of your time spent on each of the questions on the left.

(1) 0-10% (2) 10-20%
(3) 20-30% (4) 30-40%
(5) 40-50% (6) 50-60%
(7) 60-70% (8) 70-80%
(9) 80-90% (10) 90-100%

54 How many handbooks do you own:	Fill the number from below into the space provided which best answers the questions on the left.
55 How many handbooks do have in your Department:	
56 How many handbooks do you use:	
57 How many manufacturers tables do you have on your desk:	(1) None
58 How many manufacturers tables do you have in your company:	(2) One
59 How many manufacturers tables do you use:	(3) Two
60 How many textbooks are available to you:	(4) Three
61 How many textbooks do you use:	(5) Four
62 How many trade magazines are available:	(6) Five
63 How many trade magazines do you read:	(7) Six to Ten
64 How many notes from special courses do you use:	(8) Ten to Twenty
65 How many company standards are available to you:	(9) More than Twenty
66 How many company standards do you use:	

67 Is this information adequate: (1) 100% (2) 80% (3) 60% (4) 40% (5) 20% of the time. (6) Seldom

When reading trade publications, how often do you read:	(1) Always
8 Technical papers in all fields:	(2) Nearly Always
9 Technical papers you are interested in:	(3) Frequently
10 Technical papers related to your work:	(4) Seldom
11 Advertising:	(5) Never

In which of the following do you find there is inadequate information and how would you like to see it:	Fill in (1) if you feel there is sufficient information, if not, fill in the appropriate numbers from this table:
72 Gears:	(1) Sufficient Information (2) Method of Solution
73 Linkages:	(3) Listed Equations to do Calculations
74 Cams:	(4) Solved Problems (5) Monographs
75 Fasteners:	(6) Tables of Values for any Problems
76 Power Drive:	(7) Charts (8) Graphs
77 Seals:	(9) Computer Programs
78 Springs:	(0) Does not apply to you.
79 Bearings:	
80 Electromechanical Components:	
81 Fluid Power and Pneumatics:	
82 Other: _____	

To keep up to date in Design, what is a typical time you spend doing the following:	Pick a number from this list for each of the questions to the left:
83 Read Trade magazines:	(1) Less than one hour/month
84 Read Research Reports:	(2) 5 hours/month
85 Read Company Catalogs:	(3) 10 hours/month
86 Go to Workshops at Universities:	(4) 20 hours/month
87 Short Courses at Manufacturers:	(5) 30 hours/month
88 Night School:	(6) 50 hours/month
89 Correspondence School:	(7) 100 hours/month
90 Reading Technical Papers:	(8) 200 hours/month
91 Writing Technical Papers:	(9) More than 200 hours/month

92 Should specialized handbooks be introduced through: (1) A short course of instruction (2) A demonstration of its practical application (3) A motion picture (4) Audio tape deck (5) An instruction manual (6) All of these (7) No verbal introduction (8) None of these

93 Should an introduction be done: (1) Only once (2) Every several years (3) Every year (5) More Frequently (5) Not at all

97 Would you purchase a Specialized Designer's Handbook if it were available: (1) NO (2) YES, if cost were less than $5 (3) if cost were $10. (4) $15. (5) $20. (6) $30. (7) $50. (8) More than $50.

Following is a partial list of trade journals relating to Machine Design. Indicate with a check (✓) the publications which you have access to, and a cross (x) on the ones to which you refer to frequently.

1. ASHRAE Journal
2. Lubrication Engineering
3. Abrasive Engineering
4. American Machinist
5. American Scientist
6. Astronautics and Aeronautics
7. Anti-Corrosion
8. Automotive Industries
9. Aviation Week and Space Technology
10. Chartered Mechanical Engineers
11. Chemical and Engineering News
12. Consulting Engineer
13. Control Engineering
14. Corrosion Prevention and Control
15. Design Engineering
16. Engineering Education
17. Electroplating and Metal Finishing
18. Electro-Mechanical Design
19. Foundry
20. Fluid Power International
21. Fluidics Feedback
22. Fasteners
23. Hydraulics and Pneumatics
24. Hovering Craft and Hydrofoil
25. Heat Engineering
26. Heating, Piping and Air Conditioning
27. Industrial Equipment News
28. Industrial Lubrication and Tribology
29. Instrumentation Technology
30. Instruments and Control Systems
31. Journal of Metals
32. Journal of Petroleum Technology
33. Journal of Science and Technology
34. Machine Design
35. Machinery
36. Manufacturing Engineering & Management
37. Materials Engineering
38. Materials Protection and Performance
39. Materials Evaluation
40. Materials Science and Engineering
41. Mechanical Engineering
42. Metal Finishing
43. Metal Progress
44. Midwest Engineer
45. Mineral Digest
46. Modern Castings
47. Modern Metals
48. Oklahoma Professional Engineer
49. Nuclear Engineering
50. Ordnance
51. Pipe Line Industry
52. Pipe Line News
53. Plating
54. Precision Metal
55. Professional Engineer
56. Product Engineering
57. Rubber World
58. Rubber Journal
59. SAE Automotive Engineering
60. Scientific American
61. Sound and Vibration
62. Spaceflight
63. Space World
64. Springs
65. Southern Automotive Journal
66. Tire Review
67. Toding and Production
68. Traffic Engineering Control
69. Welding Engineer

VITA

Danny Otto Hoyt

Candidate for the Degree of

Master of Business Administration

Report: A STUDY OF UTILIZATION OF TRADE MAGAZINES BY MACHINE DESIGNERS IN THE TECHNOLOGY TRANSFER PROCESS: IMPLICATIONS FOR MANAGEMENT

Major Field: Business Administration

Biographical:

Personal Data: Born in Jamestown, New York, August 29, 1947, the son of Mr. and Mrs. James R. Hoyt; married November 1, 1974, to Deborah Ann Inklebarger of Starke, Florida.

Education: Graduated from Jamestown High School, Jamestown, New York, June, 1965; received the Associate of Science degree from the State University of New York at Morrisville, Morrisville, New York, with a major in Engineering Science, 1967; received the Bachelor of Science degree from Oklahoma State University, with a major in Industrial Engineering and Management, 1970; completed requirements for a Master of Business Administration degree at Oklahoma State University, Stillwater, Oklahoma, in July, 1975.

Professional Experience: Junior Tool Designer, Blackstone Corporation, Jamestown, New York, 1969.

Professional Organizations: American Institute of Industrial Engineers and Masters of Business Administration Student Association.