Perceptions About Information/Library Skills As a Tool for Lifelong Learning

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Abstract.

In the last half century written knowledge has grown exponentially and a number of new technologies have been introduced recently in order to manage and manipulate information. Engineers -- students, teaching faculty and practitioners -- have then to deal with large amounts of information as well as learn the techniques of retrieving them.

The purpose of this paper is to survey the literature in order to determine the perceptions that teaching faculty, students have about the need to develop information/library skills as a required tool to become better engineers and to advance in their professional career.

Introduction.

Typically an engineering student is confronted with a range of information systems and sources when working on a research or design project. These systems and sources appear to multiply day by day. The professional engineer is also exposed to these many choices, and to an ever growing technical literature. In this paper, we will not turn our attention to the sources of scientific and technical information themselves but into the factors affecting practitioners and students of engineering in the process of acquiring information. In order to accomplish that we will analyze several cases published in the literature, these cases will demonstrate the habits of engineers and technologists in seeking information the attitudes of students and faculty members in learning or promoting library skills. The idea behind this study is that it is important to understand the working environment of information users--engineers and students--in order to look for ways of better utilizing the vast numbers of options available.

The Engineer or Technologist at Work.

In the first part of this paper, several cases will be presented that demonstrate the importance of scientific and technical information to engineers and to those in managerial role. Since some of these cases are the result of extensive research, it can be considered that they can provide us with the sense of how information is used as well as how it is obtained.

Donald G. Marquis (1) and Thomas J. Allen from the Massachusetts Institute of Technology wrote in 1966 a paper about the flow of information in applied research and engineering development areas as compared to the use of information in areas of basic research or science. The authors indicate the existing differences between these two areas even though in each of them the accumulation of knowledge is the base for further developments. Both the scientists and technologists must maintain a current awareness of their own field, but this does not happen in a similar fashion. In technological areas the literature does not accumulate upon itself but depends a lot of the technician's own work. The production of information is secondary to the actual utilization of technological advances. There are also differences in the ways of communicating; engineers give great importance to oral communication through close associates and co-workers within their own organization and not through the invisible college. Also, technologists are employed by organizations with a specific mission such as profit or national defense, therefore, most of the information created by them might stay within the domain of the organization itself.

Marquis and Allen found that in the process of project development, information from vendors and customers rank higher than literature analysis, for example. In the area of technical literature and how it affects the project, they found that technologists appear to depend more on trade journals and books. Also, and internal technical reports are the most used form of communication. In engineering and technical areas the transmission of documentation occurs between organizations not between individuals and finally, practitioners have a limited understanding of information published in scholarly journals. The trade journals, then, are the sources to maintain up-to-date.

The next paper was written by Francis W. Wolek (2) of the University of Pennsylvania Wharton School of Finance and Commerce in 1969. It focuses on information needed by engineers in the actual work situation, specifically in engineering development projects. The author emphasized that:

"the overriding purpose of engineering is to produce a design for an operating, technological device".

To achieve this goal the engineer might work on new concepts, or may work on the modification of existing technologists. It is typical to find that in the definition phase of the project the time spent is about 5 to 10 percent while the time spend for experimental modeling and testing is from 90 to 95 percent. This implies that engineers get most of their information from their own empirical work. Because most of this empirical work is specifically related to a unique model it is not a surprise then that the flow of information relies heavily on interpersonal and local contacts. Also, it is important to mention that the more advanced the project gets the more "frozen" the design is, therefore, it becomes less and less important for engineers to divert their efforts to investigate new concepts or possibilities. As a result engineers working on development projects try to ignore information unless it has direct application to a specific task

According to Wolek, the need for outside information, such as literature analysis, patents and specifications, seem to be more important in the system definition phase. The main concept here, the author says, is that "the engineers aim to better the state of the art in competing technologies". The engineer just tries to build something better, not necessarily the best. At this stage it is important to know about performance measures, the competing groups, and the trend of these groups. That is "the historical information available about performance of technologies over time". A second major aspect of system definition is the "determination of a technological approach"; in order to achieve this aspect of their work engineers are more likely to look at the precedent technologies that are closely related to the performance level accepted, reducing in their way many possible alternatives. Therefore, based on the idea of creating new technology on precedent design we should look at the need for information at this stage. It is clear that the information needed to do design and development can be identifiable, that is; information about technological approach; component technologies and historical knowledge.

Furthermore, there are some times when the engineer needs entirely new solutions. One reason can be the need to enter into a new field; second, when following the already established design concepts the results would not have a real value. In this new situation, information is going to be found also based on precedent knowledge in a process that is not always clear but required abstractions and perceptions and perceptions for new applications. As the author concluded; "Its success depends upon the availability of information and the ability of the engineer to rise above the kind of constrained and detailed thinking required in his daily work." The engineer's professional background and the ability to transform abstracts concepts into new developments constitute the major difference from the previous approach. Other considerations as indicated by Steven Ballard (3) are the potential market demands, the willingness of the organization to take risks and the capacity of the organization to manage the process to a successful completion. The challenge here is to find appropriate information systems to help the engineer to build this background that might be separate from their regular daily work.

Another important paper was published by Arthur Gerstenfeld (4) and Paul Berger from Worcester Polytechnic Institute and Boston University respectively in 1980, they compare the different ways scientific and technical information is used. The paper is the result of an extensive survey of 300 engineers and scientists of five major U.S. corporations. The authors indicate the many evidences available in the literature that shows that in Research and Development organizations, access to scientific and technical information is necessary in order to innovate--to create new products - - as well as to maintain the technical performance of their employees, and they add that in order to maintain in competitiveness, our technology-based organizations must effectively use technical information. The results of this study can be summarized as follow: 1. Information is needed toward the end of basic research projects and toward the beginning of applied research projects. 2. Information is more likely to be written for basic research, and to be oral for applied research. 3. Useful information help to understand the nature of a basic research, but helps to improve solutions for applied research projects. 3. Written information is more often used at a later time, while oral information is used immediately. 4. In regards to major issues associated with scientific information the ranking was: a. Information access b. Information overload c. Information comprehensiveness d. Information quality and e. Information time-log. Items a. and b. where clearly the highest concerns, which relate to methods of getting information, time spent and overload. 5. As far as issues related to the use of computerized bibliographic data systems the ranking was: 1. Information access 2. Systems access 3. Information comprehensiveness 4. Response time and 5. Unfamiliarity with systems. In this case a. was clearly the top concern which deals with searching strategies and protocols.

One conclusion arrived from these results is the need to improve access to scientific and technical information, and to develop information systems geared to increase selectivity, the authors said "buried treasures are there and management must find ways to make them available." And added that traditional information systems may be inadequate to fulfill the need of many applied researchers and engineers. It is important to realize that not much is known about the information needs of engineers and technical personnel working out-side areas of research and development.

In this last area Hedvah L. Shuchman (5) of The Future Group, a consulting firm in Washington D.C., published an extensive report in 1981 representing the results of a study made on 14000 engineers in the U.S.A. engaged in all forms of engineering and technical engineering work.

In this study the author looked for the relevance of information-seeking patterns as well as the relationship that might exist between job performance, the ability to be current in technological advances and the capacity of engineers to review engineering fundamentals. It also stresses the importance of technological information, information technology, the engineer, productivity and the ability to innovate. One result in this report in relation to how engineers solve technical problems was: first was by using personal store of technical information; second by informal discussion with colleagues; in the middle was by consulting library sources and more down in the rank was using databases. These results are indeed very similar to previous studies done just for research and development personnel.

The last study to mention in this section is by Thomas E. Pinelli (6) et all from the National Aeronautics and Space Organization. Their objective was to determine current characteristics of technical communications in aeronautics, they found, for example, that engineers at NASA solved technical problems by consulting library resources in about 35 percent of the cases; or consulting one own's information or consulting with colleagues in about 90 percent of the cases. Also, about 94 percent of the engineers surveyed use the library or information center at one point during the project but only 44 percent use online databases. This study done in 1989 is one of the most recent and shows results that are consistent with previous studies.

Engineering and The Academic Library

Charlotte A. Erdmann (7) from Purdue University in a recent article quite vividly describe engineering students using the library:

> "A typical undergraduate engineering or engineering technology student uses the library to study textbooks, read reserve materials, perhaps read a few journals, and check out books. Few assignments require students to use the wealth of information stored in the library."

Graduate students are suppose to have information-gathering skills but in most cases they are not well prepared for such endeavors, the author added

Undergraduate education can be the proper ground where future engineers and technologists can develop the foundations to do information gathering effectively. There are some basic concepts such as : students need to learn to define questions, find the background information necessary to initiate a project, they also need to know how to plan a search strategy for technical information. Training in the use of electronic databases is necessary skill students must obtain during their years in college; information databases are for different purposes and have different formats. The online catalog, now available in almost every academic library, is a database often with several options and enhancements that can make a search very productive. Other databases are available in the form of CD-ROM and are most of the times the equivalent to traditional indexing and abstracting services; other databases such as CARL-UNCOVER are mounted in a local or external computer. One of the major problems is to identify what is available in which format, second to learn the basic protocols of each database, but the most important skill is to learn to develop strategies in order to refine a search avoiding overload of information and minimizing the lost of critical data. There is a very large body of literature that includes: government reports; industry reports, standards and specifications, patents and proceedings of technical meetings, all are potentially needed in the course of a project.

One area that requires more attention is the investigation of attitudes that students have about learning these skills and how these skills in their own perceptions can help them complete their education to become highly qualify technical professionals.

Several case studies about the use of the library by engineering students have been published and seem to show how students react to this kind of training. They can be used to identify attitudes and perceptions of both faculty and students in the process of learning information-gathering skills. Philip H. Kitchens (8) in 1979 reported about the experience obtained at the University of Alabama where library skills were taught as part of a general freshman required course. The evaluation of this experience showed that the attitudes of the majority of students were favorable. They appreciated getting a better understanding of the library, materials and sources of information available. Although, there is a small group that considers it boring or a duplication from the English class training.

Maurita P. Holland (9) from the University of Michigan and also 1979 reported about a library instruction project in which the author taught bibliographic skills as part of a engineering communication course where an instructor and a librarian worked together. A great concern is expressed in this article about the way students are prepared to keep up-dated in their own field. The author also reported how well receptive both faculty members and students were to the learning process of researching for technical information. The literature has many other examples where information and library skills were well received by engineering and technical students.

A more recent paper by Loretta Caren (10) from Rochester Institute of Technology described a library instruction program geared to current library technology. This project was initiated because of the realization that many users did not understand basic concepts: such as the difference between the online catalog, CD-ROM databases, online searching and searching OCLC, even though the student population at RIT as in many other technical schools they are computer literate. At this institution, as in most colleges today, students were having problems identifying the various systems and products available. Also, in this case the faculty evaluation of the seminars presented to them were very positive and the attendance to the seminars was overwhelming.

In a survey at Citadel reported by J. E. Maygard (11), 1990, faculty members were asked about how well students can do library research; how they felt about students having library instruction classes; and how important instruction is or would be to students. Interesting enough 86 percent agreed that library instruction is an important part of college education but only 33 percent offer library instruction to their students. And 68 percent of faculty surveyed admitted learning library skills on their own when in college. Although a very small sample, the result of this survey reflect general attitudes among faculty members on this issue.

In one case where faculty members are active participants in teaching library skills, it has been is reported by D. I. Ingram (12) and J.D. McCoy from the Southern College of Technology, that students have limited ability to do library research about practical problems. They--the students--do not have knowledge of technical information sources -- paper nor electronic-- as well as lacking skills in the techniques involved in doing information work.

Of course the problems of documentation go beyond library skills and are encountered also in the process of disseminating information, better known as technical writing. For example, G. R. Freimer (13) found students having difficulties interpreting citations, as well as having problems identifying different writing styles such as Turibian, MLA or APA. Interesting enough faculty members perceived that students should not have much problems with these style manuals, but this study revealed that instructors were not aware of the wide-variety of manuals available. There is another area in informational skills requires attention. This is the informal learning activities of engineers. Informal learning activities of engineers are important because it is one way they keep up with technological changes. R.M. Cervero (14) J.D. Miller and K.H. Dimmock in 1986 studied how practicing engineers learned and keep up dated. They quoted Bayton (15), 1972, who says that most of what engineers learn is in informal activities not by attending formal courses or seminars. Cervero and Miller found in their survey that 64 percent of engineers in their sample were active in informal self learning projects. This result serves to stress the need engineers have to be better equipped in information gathering skills in order to take full advantage of what is today available through electronic and traditional formats of technical information.

In conclusion, it has been said and largely documented that students need to understand that library research is a process with a pre-determined focus. They need to learn to use electronic databases for information research; they have to appreciate the role of scholarly communication in the research process; they need to organize technical information including the maintaining of records and taking notes; they need to be aware of resources, policies and procedures in the library and finally they have to evaluate information for a pre-determined reason --a project.

The Role of The Information Specialist

Hannedore Rader (15) from Cleveland State University recently said that from a recent American Library Association report (16) and from other writings information literacy can be defined as:

- "understanding the process and systems for acquiring current and retrospective information, such as systems and services for information identification and delivery;
- the ability to evaluate the effectiveness and reliability of various information channels and sources, including libraries, for various kinds of information needs;
- mastering certain basic skills in acquiring and storing one's own information in such areas as databases, spreadsheets, and word and information processing."

Rader also indicates that information literacy is the foundation for lifelong self-learning. Putting these concepts into practice, information literacy will allow engineers and technical personnel to search, organize and evaluate information when it is needed. In the academic structures, the key is to innovate and create curriculum strategies that will allow students to have those skills as part of their regular training within their own subjects of studies so they can appreciate and be able to handle similar but often complex information systems on their own in the work situation and with the intention of not just doing the daily work but in keeping up to date and for innovation.

Conclusion

The results of the literature survey in this paper demonstrates that practicing engineers are active seeker of technical information both through formal and informal channels. Engineering students although not always well prepared to handle the variety of information systems and products available, have a good appreciation for learning and using these skills in their projects. Faculty members are also appreciative of the need for information literacy but it appears that there are not many opportunities in the curriculum to motivate engineering students to learn these necessary skills in order to be not only better students but to be better practicing engineers and technologists. On the other side, librarians are more than eager to participate in information skills projects.

The survey of the literature indicates that technical information is necessary not only in the daily work of the engineer but it is essential for the individual and for the organizations for which they work to have well trained professional with these skills that can be used in their lifelong learning experience. The results could produce better motivated and more productive employees and more innovation in the work place that would translate into better products for society and more profits for the orgabization.

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