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AUTHOR Duo, Jeong-Feong; Yuen, Steve Chi-Yin
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ABSTRACT

A study investigated the availability and current use of microcomputers in industrial engineering and management education in Taiwan, Republic of China. It gathered information about the knowledge, interests, and attitudes of industrial engineering and management instructors toward microcomputers and their opinions regarding a number of computer-related topics. Data were collected through a questionnaire mailed to 221 instructors in the 19 colleges and universities in Taiwan. Responses were received from 155. Both descriptive and inferential statistics were used in the data analyses. Findings indicated that many of the instructors had received some microcomputer training; they were somewhat informed about computer knowledge; they were interested in acquiring computer skills and knowledge; and they were overwhelmingly in favor of the use of microcomputers in industrial engineering and management education. More than one-half owned a microcomputer; most had microcomputers available for their own use and/or student use in their programs; more than 60 percent were dissatisfied with the number of microcomputers available in their programs; and the majority were dissatisfied with the quantity and quality of software. No single characteristic strongly distinguished microcomputer users from nonusers. Instructors with greater exposure to microcomputers has more positive attitudes to microcomputers. (YLB)

A National Study of Microcomputer Use in Industrial Engineering and Management Education in Taiwan, Republic of China

by

Jeong-Feong Duo, Ph.D.

National Taipei Institute of Technology

Department of Industrial Engineering

Taiwan, Republic of China

and

Steve Chi-Yin Yuen, Ph.D.

The University of Southern Mississippi

Business and Industrial Education

Hattiesburg, Mississippi

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The microcomputer prevails today in science, business, and industry , and the use of microcomputers in vastly new applications is expected at tremendous rate through the 1990's and into the year of 2000 (Uthe, 1982). It is estimated that 90 percent of the computing will be done at the work station level, and over 36 million work stations will be put into business and industry in the United States by 1990 (Dicasali, 1984). As individual work stations, microcomputers have allowed the end users to become less dependent on central computer services. Thus, the impact of microcomputer technology has dramatically changed the role of the mainframe computer. James Lovell, a former astronaut and now communication executive, indicates that there will be one personal computer for every two workers by 1990, and that comes close to the ratio of telephones to workers (The Editors, 1984).

Today, managers, professionals, and workers are increasingly using microcomputers to assist them in their problem solving, planning activities, and decision-making to improve their productivity. Puette (1986) indicates that microcomputers can serve as an important tool for single task/integrated applications, shared resources, information access and management, and communication to increase productivity.

The microcomputer has become a versatile, and cost-effective engineering tool as well as an important teaching tool in industrial engineering and magement education. In the 1990s, students in this field of education will be increasingly involved in many technological changes brought about by the use of microcomputers. Microcomputers will

be used to teach, reinforce, and maintain student interests, while presenting content and concepts previously taught by traditional methods. These are methods that the microcomputer will be used to alter the way subjects are taught and the way future industrial engineering and management students learn.

Changes in business and industry that result from the microcomputer revolution will have a profound impact upon industrial engineering and management. Instructors in these programs are beginning to recognize these needs and are attempting to meet the challenge.

Need for the Study

The microcomputer industry is only about a decade old, however, it has already made a major impact on business and industry. Microcomputers have become a cost-effective engineering and business tool.

Recently, microcomputer hardware has become more powerful, portable, durable, and affordable, and the software has become more reliable, sophisticated, and integrated as well as easier to use (Kleinberg, 1986 ; Klenk, 1985). This has led to their being accepted and adopted by industrial engineering and management education.

Whitehouse and Bernkrant (1981), in a survey of industrial engineers and managers' interest on microcomputer applications, found a wide range of interest from industrial engineers and managers. More than half of the respondents expressed high or moderate interest in almost all 30 possible applications. Of highest interest on the list were statistical analysis of data, development of standard data, critical path analysis, assembly line balance, rate of return analyzer, and PERT. Today, microcomputers are used by industrial engineers and managers in many areas. Some of these are Computer-Aided Design (CAD), Computer Aided

Manufacturing (CAM), computer graphics, manufacturing planning and control, operations research, simulation, project management, human factors engineering, robotics, quality control, inventory analysis, motion and time study, and data base management (Browne, 1985; Conrad, 1984; Holland, 1984; Jay, Zandt, & Hanson, 1984; Pruett & O'Donnell, 1985; Ranky, 1986; Sepehri, 1984).

The microcomputer is a useful tool for most levels of manufacturing planning and control(Sepehri, 1984). The benefits gained from the use of computerized manufacturing planning and control systems are significant . Inventories can be reduced by an average of 20 to 30 percent; inventory errors are kept below 1 precent; and the inventory shortages is reduced by up to 80 percent. On the productivity side, output per man-hour is typically up 10 percent on average, while over time may decline by up to 50 percent (Browne, 1985; Holland, 1984). The development of a fourth generation computer language and the advent of the powerful 32-bit microcomputers will enable the manufacturing planning and control professional to deal with the most demanding of manufacturing applications at the the microcomputer level(Jay, Zandt, & Hanson, 1984). This indicates that engineers and managers will be now able to easily handle the jobs information needs using microcomputers.

Without a doubt, microcomputers are now bring processing power down into the factory where data can be directly accessed and manipulated (Sibthorp, 1982; Wolfe, 1982). Microcomputers will enable engineers to access other machines, download portions of program from other machines , and perform selected functions on a microprocessor in a work station environment. Microcomputers also will enable engineers to collect data for eventual transfer to other computers with a work station (Pritsker,

1985). Dicasali (1984) indicated that microcomputer work stations will become so powerful that the mainframe will become simply a repository of information over the next 10 years.

Microcomputers are changing the business office. They are now being used for word processing, accounting, filing, invoicing, payroll, inventory control, general ledger, sales analysis, cost analysis, budget projections, and market analyses and projection. The use of microcomputers will cause an organization revolution in the office of the future much as the assembly line did for the factory worker.

The microcomputer revolution will affect the efficiency and productivity of industrial engineering and management. In order to realize improvements in efficiency and productivity in the use of microcomputers in industrial engineering and management, instructors in industrial engineering and management must be prepared to use microcomputers successful through inservice training activities. Before providing such training for industrial engineering and management instructors, however, the instructors' attitudes toward using microcomputers must be taken into consideration. The attitudes of each instructor toward microcomputers and their uses in industrial engineering and management can greatly influence the instructors' commitment to and the subsequent success of using microcomputers in industrial engineering and management education programs. Therefore, it is important to gather nationwide information about industrial engineering and management instructors, their computer knowldege and skill, as well as their opinions regarding a number of computer-related issues so that effective strategies and professional development activities can be developed to meet their needs, to help them to break

down barriers to using the microcomputer, and to become successful in their uses of microcomputers in industrial engineering and management education. In addition, since many people believe that microcomputers will improve productivity, it is worthwhile to determine if industrial engineering and management instructors also share that belief. An assessment of instructors' attitudes should precede any full-scale nationwide commitment to microcomputers in industrial engineering and management education.

Statement of the Problem

The purpose of this study was to determine the availability and current use of microcomputers in industrial engineering and management education in Taiwan, Republic of China. The study also gathered information about the knowledge, interests, and attitudes of industrial engineering and management instructors toward microcomputers as well as their opinions regarding a number of computer-related topics. Specific research questions posed for the study were:

1. What are the knowledge, attitudes, and interests of instructors toward the use of microcomputers in industrial engineering and management education?

2. Do industrial engineering and management instructors who use microcomputers differ from those who do not? If so, how?

3. Are there differences in attitudes toward using microcomputers in industrial engineering and management education among various groups of instructors in terms of selected characteristics (i.e., sex, age, educational level, faculty rank, microcomputer ownership, availability of microcomputers, microcomputer training, and utilization of microcomputers)?

Methodology

At the time of this study, there were nineteen colleges and universities offering industrial engineering, industrial management, and industrial engineering and management programs in Taiwan, Republic of China. The population for this study consisted of all industrial engineering and management instructors in the nineteen colleges and universities in Taiwan, Republic of China during academic year 1986-1987.

Instrumentation

The data were collected through a mailed questionnaire. In order to answer the research questions, a seven-page questionnaire consisting of 23 questions and statements was developed to gather data. The questionnaire was constructed in two parts. The first part was designed to provide a demographic profile of the industrial engineering and management instructors. The second part was designed to gather information about the knowledge, interests, and attitudes of instructors toward microcomputers as well as their opinions regarding a number of computer-related topics.

Before the questionnaire was applied to the sample, a jury of experts reviewed the statements and questions on the questionnaire. The questionnaire was then revised and field tested in Taiwan. The results of the pilot study indicated that the reliability of the attitudes scale of the questionnaire using Cronbach's alpha was 0.89.

Data Collection

Two hundred twenty-one questionnaires were sent to industrial engineering and management instructors in the nineteen colleges and universities during Spring term 1987. A follow-up mailing was made in an

attempt to ensure high return after the deadline. As a result, the total number of questionnaires returned was 155 (70.1%).

Data Analysis

Descriptive and inferential statistics were employed in the study. Descriptive statistical analysis provided answers to questions relative to instructors' knowledge and interests, and their opinions regarding a number of computer-related issues. Chi-square analysis and one-factor analysis of variance were the major inferential statistical procedures used in the study. The chi-square test was used to determine whether microcomputer user and nonuser responses were different. Computed chi-square values were interpreted at the 0.01 level of significance with degrees of freedom depending on the number of categories being compared .One-factor analysis of variance was used to investigate the difference in instructors' attitudes toward using microcomputers in industrial engineering and management between/among various groups of instructors in relation to selected characteristics.

Findings

Analysis of the background information indicates that more than half (53.2%) of the industrial engineering and man gement instructors own a microcomputer. Eighty-five percent of the instructors indicate that they have microcomputers available for use in their programs. Ninety-four percent of the instructors report that they have microcomputers available for student use.

Instructors were asked whether they had been trained to use a microcomputer. The responses show that 70.4 percent of industrial engineering and management instructors have received some kind of microcomputer training. Usually, they are self-taught or receive training from a college or university.

Instructors were asked to indicate how well informed they were about various aspects of microcomputer hardware and software. As a group, the majority of instructors (75% or more) reported that they were somewhat or fairly well informed about any microcomputer knowledge or skill area probed.

Instructors were asked to identify individuals and groups who had encouraged them to use microcomputers for instructional purposes. The greatest sources of encouragement were the department-head (79.4%), followed by teaching colleagues (77.5%), and friends (67.1%).

Industrial engineering and management instructors' were asked to respond to a question about their interest in taking a course or attending a workshop to learn computer-assisted instruction and computer-managed instruction. The majority of the instructors (80.2%) expressed an interested in learning computer-assisted instruction and computer-managed instruction.

At the time of survey, fifty-one percent of the instructors used microcomputers for instructional purposes. Of this group, 16.7% used the microcomputer daily, 50.0 % were weekly users, and 33.3 % were monthly users. The average years of instructors microcomputer experience in their program was 1.9 years. Sixty-two percent of the instructors reported that they did not have enough microcomputers available for student use in their programs. The majority of instructors (61%) were dissatisfied with the quality of software available. Seventy-five percent of instructors indicated that they did not have enough software for instructional used. Table 1 shows the areas of microcomputer uses reported by the instructors who use microcomputers in industrial engineering and management education.

Insert Table 1 about here

The results of the chi-square test to determine the differences between industrial engineering and management instructors who use microcomputers (referred to as users) and instructors who do not (nonusers) are shown in Table 2. None of the selected instructor demographic characteristics were found to have significant difference between microcomputer users and nonusers. It is apparent that no single characteristic strongly distinguishes users from nonusers.

Insert Table 2 about here

Instructors' attitudes toward the use of microcomputers in industrial engineering and management education was measured based on an analysis of the data received from 20 Likert type attitude items of the questionnaire. It was found that the total attitude scores ranged from 47 to 99 with a maximum possible score of 100. The mean score for the attitude section was 79.1 and the standard deviation was 8.8. It was revealed that 98.7 % of the instructors professed positive attitudes toward microcomputers, with a score greater than 60 (neutral position).

The results of the analysis of variance used to test for difference among groups of industrial engineering and management instructors with respect to their characteristics are shown in Table 3. There were significant differences in instructors' attitudes toward using microcomputers between/among various groups of instructors in terms of their microcomputer training, ownership of a microcomputer, and utilization of microcomputers.

Insert Table 3 about here

Summary and Recommendations

The results of the study indicate that a great number of industrial engineering and management instructors have received some microcomputer training . They reported that the greatest sources of encouragement to use microcomputers in their programs came from the department head, teaching colleague and friends. Industrial engineering and management instructors were somewhat informed about computer knowledge and they were interested in acquiring necessary computer skills and knowledge. They were overwhelmingly in favor of the use of microcomputers in industrial engineering and management education.

More than half of the industrial engineering and management instrucrots owned a microcomputer. Most instructors indicated that they had microcomputers available for their use or/and student use in their programs. However, more than 60% of instructors reported that they were dissatisfied with the number of microcomputers available in their programs. The majority of instructors also indicated that they did not have enough software for instructional uses and were not satisfied with the quality of existing software.

Half of the industrial engineering and management instructors surveyed used microcomputers for instructional purposes. However, it was found that there was no single characteristics that strongly distinguished microcomputer users and nonusers.

Findings from this study indicated that the selected instructor characteristics of ownership of a microcomputer, microcomputer training

, and utilization of microcomputers were significantly related to their attitudes toward using microcomputers in industrial engineering and management education. Industrial engineering and management instructors who have had training in the use of microcomputers were more in favor of using microcomputers in industrial engineering and management education than those who have not had such training. In addition, instructors who have used microcomputers for instructional purposes were more positive toward the use of microcomputers in industrial engineering and management education than those who have not. These positive attitudes may be a result of those instructors' greater exposure to microcomputers. Industrial engineering and management instructors who owned a microcomputer also expressed more support for the use of microcomputers in industrial engineering and management education than nonowners.

Based on the findings of this study, the following recommendations are made for those involved in the implementation of microcomputers in industrial engineering and management education:

1. More microcomputers should be made available for use by instructors and students.

2. Development of high quality and creative software and courseware for industrial engineering and management education should be encouraged.

3. Workshops or inservice training programs should be developed to increase industrial engineering and management instructors' familiarity with and knowledge about microcomputers.

4. The Ministry of Enducation should provide the leadership in developing and providing inservice trainings and seminars for

instructors in computer-assisted instruction, computer-managed, instruction, and microcomputer applications.

5. Since department heads were reported to have the most influence on encouraging instructors to use microcomputers in industrial engineering and management education, department heads should provide support and pay more attention to encourage instructors in using microcomputers in their programs.

6. Industrial engineering and management education programs should require students to have at least one microcomputer course in industrial engineering and management to learn how to operate microcomputers and how microcomputers can be used in the field of industrial engineering and management.

7. The Ministry f Education, professional engineers associations, colleges and universities, should support information dissemination and provide expertise and resources to assist instructors to implement and successfully use microcomputers in industrial engineering and managemnt education programs.

8. Support should be provided for industrial engineering and management instructors to update themselves and their instructional programs in this rapidly changing information age technology.

9. The Ministry of Education and the National Science Council should provide funding for research to evaluate the costs and effectiveness of microcomputers in industrial engineering and management education. In addition, guidelines and standards for the successful implementation of microcomputers in industrial engineering and management education programs should be developed.

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Table 1

Percentages of Instructors Reporting Areas of Microcomputer Use

Area	Number	Percent
CAI/CMI	47	65.3
CAD/CAM	17	23.6
Computer graphics	26	36.1
Computer integrated manufacturing	7	9.7
Robotics	4	5.6
Quality control	35	48.6
Manufacturing planning	36	50.0
Inventory analysis	33	45.8
Motion and time study	19	26.4
Human factors engineering	9	12.5
Operations research	38	52.8
Other	5	6.9

Note. Percentages are based on the total number of user respondents (N= 72). Percentages total more than 100.0 percent because respondents were allowed more than 1 response.

Table 2

Relation Between Selected Instructor Characteristics and Microcomputer Use

Variable	Number		Chi-square
	Users	Nonusers	
Sex			
Male	63	53	2.07
Female	9	16	
Age			
Under 30 years	17	11	2.62
30-39 years	44	41	
40-49 years	7	11	
Over 49 years	4	6	
Educational Level			
Associate's degree	6	5	2.59
Bachelor's degree	13	16	
Master's degree	44	35	
Doctor's degree	8	13	
Faculty Rank			
Professor	5	10	3.31
Associate professor	16	16	
Lecturer	34	31	
Teaching assistant	16	12	
Other	1	0	

Note. None of the variables were found significant at 0.01 level.

Table 3

Analysis of Variance Summaries of Instructors' Attitudes Toward Using Microcomputers by Selected Variable

Variable	df	SS	MS	F
Sex	1	23.65	23.65	0.30
Age	3	454.12	151.37	1.99
Educational level	3	358.88	119.63	1.55
Faculty rank	3	342.10	114.03	1.49
Owner of a microcomputer	1	1096.31	1096.31	15.39*
Availability of microcomputers	1	0.19	0.19	0.01
Microcomputer training	1	1523.24	1523.24	22.10*
Utilization of microcomputers	1	819.20	819.20	10.65*

*p<.01